DEPARTMENT OF
STATISTICS

MSc AND POSTGRADUATE DIPLOMA IN STATISTICAL SCIENCE

2018-2019

STUDENT HANDBOOK

This handbook applies to students starting the MSc or PG Diploma in Statistical Science in Michaelmas term 2018. The information in this handbook will be different for students starting in other years.

The Examination Regulations relating to this course are available at **http://www.admin.ox.ac.uk/examregs/.**
If there is conflict between information in this handbook and the Examination Regulations, then you should follow the Examination Regulations. If you have any concerns, please contact the Academic Administrator in the Department of Statistics, **academic.administrator@stats.ox.ac.uk**.

The information in this handbook is accurate as at September 2018, however it may be necessary for changes to be made in certain circumstances, as explained at **www.graduate.ox.ac.uk/coursechanges.** If such changes are made, the department will publish a new version of this handbook together with a list of the changes and students will be informed.

Version 1.2 – Update to sections 4.1, 4.2, 4.7 following publication of the examination conventions.

CONTENTS

MSc/ PG DIPLOMA IN STATISTICAL SCIENCE 2018/2019

1. Introduction

1.1 Welcome and introduction

We welcome you to the Department of Statistics and our MSc programme in Statistical Science. The programme is demanding, but we are here to help and want to see you succeed. All the best for your academic year 2018-2019.

Charlotte Deane (Head of Department)

This handbook is designed to help you understand the course structure for the MSc and PG Diploma in Statistical Science, including assessment; information on supervision; key contacts; facilities and where you can go to if you need support.

Other Key Sources of Information

- Timetables, announcements, student handbook, information on practicals, other course documents and links to course material are found on the MSc in Statistical Science WebLearn site using the Single Sign On login at **https://weblearn.ox.ac.uk/portal/site/:mpls:stats:msc2018**

- MSc and PG Diploma webpage: **https://www.stats.ox.ac.uk/student-resources/msc-in-statistical-science/**

- Examination regulations: **http:/www.admin.ox.ac.uk/examregs/**

- Examination conventions: These will be found on the MSc and PG Diploma WebLearn site at **https://weblearn.ox.ac.uk/portal/site/:mpls:stats:msc2018**

- General University information for students and access to Student Self-Service can be found via the University's Student website at **www.ox.ac.uk/current_students/index.html**

- College handbooks: These are available on the websites of each college.

1.2 Course contacts

Dr George Deligiannidis is the MSc Course Co-ordinator and makes the day-to-day arrangements for the course. There is also a formally constituted departmental Teaching Committee which oversees the programme.

MSc Course Co-ordinator	Prof. George Deligiannidis	deligian@stats.ox.ac.uk
MSc Course Administrator	Hannah Harrison	hharriso@stats.ox.ac.uk
Head of Department of Statistics	Prof. Charlotte Deane	deane@stats.ox.ac.uk
Director of Studies and Chair of Teaching Committee	Dr Neil Laws	laws@stats.ox.ac.uk
Director of Graduate Studies	Prof. Gesine Reinert	reinert@stats.ox.ac.uk
Deputy Director of Graduate Studies	Prof. Geoff Nicholls	nicholls@stats.ox.ac.uk
Academic Administrator	Jan Boylan and Margaret Sloper	academic.administrator@stats.ox.ac.uk
Disability Co-ordinator	Jan Boylan	
Statistics Library	c/o Hannah Harrison	lib@stats.ox.ac.uk
Statistics Reception	Emma Bodger	reception@stats.ox.ac.uk
IT support		ithelp@stats.ox.ac.uk

Graduate Liaison Group representatives see: http://www.stats.ox.ac.uk/student-resources/research-degrees/graduate-liaison-group/

1.3 Email

You will be allocated an Oxford email account. Important information will be sent to this account and you are expected to check this account **at least once per working day**.

1.4 Term dates and residence requirements

In the first term, lectures begin on Monday 8 October. Lecturing is concentrated in three eight-week terms (weeks 1-8):

MICHAELMAS TERM - Sunday 7 October 2018 to Saturday 1 December 2018
For Michaelmas Term you should plan on being in Oxford for Week 9, i.e. 2-6 December as there will be a deadline for submission of assessed work on Wednesday in week 9.

HILARY TERM - Sunday 13 January 2019 to Saturday 9 March 2019
For Hilary Term you should plan on being in Oxford for weeks 9 and 10, i.e. 10-22 March as there will be a deadline for submission of assessed work on Wednesday in week 10.
You should also be in Oxford during Week 0 of Hilary Term (from 8 January) as there will be a test that week – the results of that test will not count towards the final degree mark but are to help students and their supervisors assess progress.

TRINITY TERM - Sunday 28 April 2019 to Saturday 22 June 2019.
You will also need to be in Oxford in Week 0 of Trinity Term (25 April onwards) as an assessed practical will start on Friday 26 April.
After the end of Trinity Term, MSc students should remain in Oxford through the summer to do their project work, although a holiday may be taken during this period.

After the end of Trinity Term, MSc students should remain in Oxford throughout the summer to continue work on their dissertation project although a holiday may be taken during this period.
There are minimum residence requirements for the degree. Students must have lived in college-approved accommodation within the University for at least six weeks for three terms and having paid the appropriate fees. If you are unable to keep the required number of terms because of illness or other reasonable cause, the University Proctors may excuse you from part of statutable residence. Students living out of college must reside within 25 miles of Carfax in the centre of Oxford.

Dispensation from the residence limits will only be granted by the Proctors in exceptional circumstances. Applications need to be made through your College Office. If you live outside the residence limits without permission, you will not fulfil the statutory requirements and may not be allowed to enter for examinations.

1.5 Assessment dates

Mock assessed practical: submission date: 12 noon, Wednesday 24 October 2018
Assessed practical 1: submission date: 12 noon, Wednesday 14 November 2018
Assessed practical 2: submission date: 12 noon, Wednesday 5 December 2018

Week 0 test – 'collection': provisional date: 2 pm, Thursday 10 January 2019
Assessed practical 3: submission date: 12 noon, Wednesday 13 March 2019
Group Assessed practical: submission date: 12 noon, Wednesday 20 March 2019

Week-long practical: provisional submission date: 12 noon, Monday 6 May 2019
Provisional date for start of MSc examinations: Monday 27 May 2019
Deadline for submission of dissertation: 12 noon, Monday 9 September 2019

The results of the test in week 0 of Hilary Term (provisional date 10 January 2019) do not count towards the final degree mark but are to help students and their supervisors assess progress. You are therefore expected to attend.

1.6 Locations

Lectures and classes will be given in LG.01, the large lecture theatre and LG.02, the IT computer laboratory, in the Department of Statistics, 24-29 St Giles'. A map can be found at https://www.ox.ac.uk/visitors/map.

Mobile phones should be turned off when entering the lecture theatre. Food and drink may not be taken into lecture rooms or IT computer laboratory.

2. Course Information

2.1 Overview

The Master of Science by Coursework (MSc) in Statistical Science is a 12-month full-time programme running from October to September. It provides a broad high-level training in applied and computational Statistics, statistical machine learning, and the fundamental principles of statistical inference. Training is delivered through mathematically-demanding lectures and problems classes, hands-on practical sessions in the computing laboratory, report writing and dissertation supervision.

The 9-month Postgraduate (PG) Diploma in Statistical Science programme runs from October to June. It has no dissertation and greater weight is given to the basic parts of the course than in the case of the MSc.

The initial registration for the MSc or PG Diploma may be changed either way up to the last day of Hilary Term, subject to approval by the Director of Graduate Studies.

The MSc in Statistical Science and the PG Diploma in Statistical Science are awards at Frameworks for Higher Education Qualifications (FHEQ) level 7. The University does not assign credit values for the majority of its awards.

2.2 Course aims

The aims of the programme are that students:

- learn a range of statistical methods, especially modern, computer-intensive methods;
- are able to choose and adapt appropriate statistical and computational methods when faced with a problem of data analysis;
- are able to implement the analysis on a computer;
- develop the skills to communicate their results clearly and succinctly.

2.3 Intended learning outcomes

- Lectures provide information for students to gain a full understanding of the general theory and practice of statistical analysis at an advanced level appropriate for MSc study. Lectures are provided on core topics which cover some of the fundamentals of statistics, statistical theory, a wide range of statistical methods, R programming; core material also covers modern computational aspects of statistics through lectures on a range of further statistical methods and statistical data mining and machine learning.
- Optional topics are provided on further statistical methodology and applications including for example courses in statistical genetics, advanced simulation methods and actuarial science.
- Non-examinable skills support lectures are provided on report writing and LaTeX document production.
- Recommended reading is provided for all modules of the course in advance in this student handbook
- Course assignments are provided to further understanding and extend knowledge in modules, together with example classes covering problem solving.
- Practical sessions enable students to undertake practical statistical data analysis that complement lectures. They enable students to learn statistical computing skills using modern statistical software such as R, and to learn to write a report on the statistical analysis of data.

- Working on a dissertation enables MSc students to undertake an in-depth study of a statistical problem involving modelling, computing and data analysis, usually involving a body of real data. It enables students to learn to undertake directed research, report writing and communication of research results.

2.4 Course structure

For **MSc students** the overall assessment is based on four parts:

Written Examination Paper (i) *Principles of Statistical Analysis*
Written Examination Paper (ii) *Further Statistical Methodology*
Assessed Practical Work
Dissertation.

For **Postgraduate Diploma students** the overall assessment is based on three parts:

Written Examination Paper (i) *Principles of Statistical Analysis*
Written Examination Paper (ii) *Further Statistical Methodology*
Assessed Practical Work.

For both the MSc and the Diploma, candidates can pass, pass with merit, pass with distinction, or fail.

Written Examination Paper (i) *Principles of Statistical Analysis*

This examination paper consists of questions taken from the core subject areas:

SM1 Applied Statistics
SM3 Foundations of Statistical Inference
SM5 Statistical Programming

and also from the optional subjects:

SM7 Probability and Statistics for Network Analysis
SM9 Graphical Models
SM10 Actuarial Science
SM11 Stochastic Models in Mathematical Genetics
SM13 Algorithmic Foundations of Learning

Two questions will be set on each course. Students should answer 5 questions including at least one question from each of 4 different courses.

Written Examination Paper (ii) *Further Statistical Methodology*

This examination paper consists of questions taken from the core subject areas:

SM2 Computational Statistics
SM4 Statistical Machine Learning
SM6 Bayes Methods

and also from the optional subjects:

SM8 Advanced Topics in Statistical Machine Learning
SM12 Advanced Simulation Methods
SM14 Topics in Computational Biology

Two questions will be set on each course. Students should answer 5 questions including at least one question from each of 4 different courses.

Please note that this examination setup means that it is not possible to do zero optional courses in one term and compensate by doing an additional option in the other term.

Assessed Practical Work

There will be a number of assessed computer-based practical assignments in Michaelmas Term and Hilary Term. One practical will be assessed by group work in Hilary Term. There is also a week-long practical assessment in Trinity Term.

Dissertation

MSc students must submit a dissertation of no more than 12,000 words. The dissertation project is mainly carried out over the summer period from early June to the dissertation submission date which noon on the second Monday in September (9 September in 2019).

Collection

A 'collection' – a test on topics studied in Michaelmas Term – will take place in the Department in week 0 Hilary Term (provisionally 10 January 2019). This does not form part of the final assessment for the course.

Research-Teaching Nexus

The Department of Statistics has an international reputation for its research profile. The University of Oxford believes that there are many benefits to the teaching of its courses that are a consequence of this high level of research activity. The tutors and lecturers with whom you will interact during this course are not only employed to teach you, but are also, in many cases, actively engaged in one or more of the wide range of research projects that contribute to the Department's research reputation. Many of the individual academic staff in this Department are recognised internationally as leaders in their own field of specialisation.

The impact of research on teaching in this department may take many forms: tutors and lecturers include their own data or ideas from research in their teaching: the regular updating of reading lists and curricula to reflect research developments; the development of research skills and research-based approaches to study through participation in the MSc research project; access to research seminars; opportunities to meet with research students and members of the faculty, particularly at the research project stage; experience of preparing research reports for external publication in some cases. In general you will be encouraged to develop the ability to interpret and critically appraise new data and to critically appraise research literature.

2.5 Timetables and lectures

Lectures for the MSc/ PG Diploma in Statistical Science are shown on **timetables,** available via WebLearn, **https://weblearn.ox.ac.uk/portal/site/:mpls:stats:msc2018** at the beginning of each term. Students should discuss with their departmental supervisor which optional lectures to attend. Students are expected to complement the contents of lecture courses by further independent reading from books suggested by lecturers or supervisors.

Lecture Courses by Term

	Michaelmas	**Hilary**
Paper I core	SM1 Applied Statistics SM3 Foundations of Statistical Inference SM5 Statistical Programming	
Paper I optional	SM7 Probability and Statistics for Network Analysis SM9 Graphical Models SM10 Actuarial Science SM11 Stochastic Models in Mathematical Genetics SM13 Algorithmic Foundations of Learning	
Paper II core		SM2 Computational Statistics SM4 Statistical Machine Learning SM6 Bayes Methods
Paper II optional		SM8 Advanced Topics in Statistical Machine Learning SM12 Advanced Simulation Methods SM14 Topics in Computational Biology
Skills	Introduction to LaTeX Report Writing Case Studies in Statistical Science	Case Studies in Statistical Science

2.6 Lecture synopses

2.6.1 Examination Paper (i) *Principles of Statistical Analysis*

CORE TOPICS

SM1 Applied Statistics – 13 lectures MT
One non-assessed practical, two assessed practicals.

Aims and Objectives
The course aims to develop the theory of statistical methods, and also to introduce students to the analysis of data using a statistical package.

Synopsis
The normal linear model: use of matrices, least squares and maximum likelihood estimation, normal equations, distribution theory for the normal model, hypothesis tests and confidence intervals.

Practical aspects of linear models and analysis of variance: multiple regression, categorical variables and interactions, blocks and treatments, orthogonality, model selection (including AIC, but not the derivation of AIC), fit criteria, use of residuals, outliers, leverage, model interpretation.

Normal linear mixed models, hierarchical models.

Generalised Linear Models: logistic regression, linear exponential families and generalized linear models, scale parameter, link functions, canonical link. Maximum likelihood fitting. Iteratively reweighted least squares. Asymptotic theory: statement and applications to inference, analysis of deviance, model checking, residuals.

Reading
A. C. Davison, *Statistical Models*, CUP, 2003
J.J. Faraway, *Linear Models with R*, Chapman and Hall, 2005
A. J. Dobson and A.G Barnett, *An Introduction to Generalized Linear Models*, Chapman and Hall, 2008
J.J. Faraway, *Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models*, Chapman and Hall, 2006

Further Reading
F. L. Ramsey and D. W. Schafer, *The Statistical Sleuth: A Course in Methods of Data Analysis*, 2nd edition, Duxbury, 2002.

SM3 Foundations of Statistical Inference – 16 lectures MT

Aims and Objectives
Understanding how data can be interpreted in the context of a statistical model. Working knowledge and understanding of key-elements of model-based statistical inference, including awareness of similarities, relationships and differences between Bayesian and frequentist approaches.

Synopsis
Exponential families: Curved and linear exponential families; canonical parametrization; likelihood equations. Sufficiency: Factorization theorem; sufficiency in exponential families.

Frequentist estimation: unbiasedness; method of moments; the Cramer-Rao information inequality; Rao-Blackwell theorem: Lehmann-Scheffé Theorem and Rao-Blackwellization; Statement of complete sufficiency for Exponential families.

The Bayesian paradigm: likelihood principal; subjective probability; prior to posterior analysis; asymptotic normality; conjugacy; examples from exponential families. Choice of prior distribution: proper and improper priors; Jeffreys' and maximum entropy priors. Hierarchical Bayes models.

Decision theory: risk function; Minimax rules, Bayes rules. Point estimators and admissibility of Bayes rules. The James-Stein estimator, shrinkage estimators and Empirical Bayes. Hypothesis testing as decision problem.

Reading

P. H. Garthwaite, I. T. Jolliffe and Byron Jones, *Statistical Inference,* 2nd edition, Oxford University Press, 2002.
G.A.Young and R.L. Smith, *Essentials of Statistical Inference*, Cambridge University Press, 2005.
T. Leonard and J.S.J. Hsu, *Bayesian Methods*, Cambridge University Press, 2005.

Further reading

D. Barber, *Bayes Reasoning and Machine Learning*, Cambridge University Press, 2012.
D. R. Cox, *Principles of Statistical Inference*, Cambridge University Press, 2006.
H. Liero and S Zwanzig, *Introduction to the Theory of Statistical Inference*, CRC Press, 2012.

SM5 Statistical Programming - 16 hrs lectures

Two non-assessed practicals and a Trinity Term assessed practical.

- Basic use of R and R Studio.
- Basic data structures in R.
- Functions, loops, and vectorization.
- Input and output of data.
- Graphics and data visualization with R.
- Simulation and numerical methods, including optimization.
- Debugging, testing, benchmarking and profiling R functions.
- Assessing and optimising R code, algorithmic complexity.
- Object oriented programming.
- Literate Programming, reproducible research, best practices in scientific programming.

Reading

Crawley M. J. (2013) The R Book. Wiley, 2nd edition.
Wickham H. (2014) *Advanced R*. Chapman & Hall.

Other reading

Chambers (2010) - *Software for Data Analysis: Programming with R*, Springer.
Venables, W. N. and Ripley, B. D. (2002) *Modern Applied Statistics with S.* Springer.
Braun, W. J. and Murdoch, D. J. (2007) *A First Course in Statistical Programming with R.* CUP.

Dalgaard, P. (2009) *Introductory Statistics with R.* Second Edition. Springer.
Murrell P. (2006) *R Graphics*. Chapman & Hall, 2nd edition.
Sarkar D. (2008) *Lattice: Multivariate Data Visualization with R.* Springer.

Spector, P. (2008) *Data Manipulation with R.* Springer
Wickham H. (2009) *ggplot2: Elegant Graphics for Data Analysis*. Springer

OPTIONAL TOPICS

SM7 Probability and Statistics for Network Analysis – 14 lectures and two practicals MT

Aims and Objectives
Many data come in the form of networks, for example friendship data and protein-protein interaction data. As the data usually cannot be modelled using simple independence assumptions, their statistical analysis provides many challenges. The course will give an introduction to the main problems and the main statistical techniques used in this field. The techniques are applicable to a wide range of complex problems. The statistical analysis benefits from insights which stem from probabilistic modelling, and the course will combine both aspects.

Synopsis
Exploratory analysis of networks. The need for network summaries. Degree distribution, clustering coefficient, shortest path length. Motifs.

Probabilistic models: Bernoulli random graphs, geometric random graphs, preferential attachment models, small world networks, inhomogeneous random graphs, exponential random graphs.

Small subgraphs: Stein's method for normal and Poisson approximation. Branching process approximations, threshold behaviour, shortest path between two vertices.

Statistical analysis of networks: Sampling from networks. Parameter estimation for models. Inference from networks: vertex characteristics and missing edges. Nonparametric graph comparison: subgraph counts, subsampling schemes, MCMC methods. A brief look at community detection. Examples: protein interaction networks, social ego-networks.

Reading
R. Durrett, *Random Graph Dynamics*, Cambridge University Press, 2007
P. Grindrod, Mathematical Underpinnings of Analytics, Oxford University Press, 2015
R.v.d. Hofstad, Random Graphs and Complex Networks, Manuscript available at
http://www.win.tue.nl/~rhofstad/
E.D Kolaczyk and G. Csádi, *Statistical Analysis of Network Data with R*, Springer, 2014
M. Newman, *Networks: An Introduction*. Oxford University Press, 2010

SM9 Graphical Models – 16 lectures MT

Aims and Objectives
This course will give an overview of the use of graphical models as a tool for statistical inference. Graphical models relate the structure of a graph to the structure of a multivariate probability distribution, usually via a factorisation of the distribution or conditional independence constraints.

This has two broad uses: first, conditional independence can provide vast savings in computational effort, both in terms of the representation of large multivariate models and in performing inference with them; this makes graphical models very popular for dealing with big data problems. Second, conditional independence can be used as a tool to discover hidden structure in data, such as that

relating to the direction of causality or to unobserved processes. As such, graphical models are widely used in genetics, medicine, epidemiology, statistical physics, economics, the social sciences and elsewhere.

Students will develop an understanding of the use of conditional independence and graphical structures for dealing with multivariate statistical models. They will appreciate how this is applied to causal modelling, and to computation in large-scale statistical problems.

Synopsis
Independence, conditional independence, graphoid axioms.
Exponential families, mean and canonical parameterisations, moment matching; contingency tables, log-linear models.
Undirected graphs, cliques, paths; factorisation and global Markov property, Hammersley-Clifford Theorem (statement only).
Trees, cycles, chords, decomposability, triangulation. Maximum likelihood in decomposable models, iterative proportional fitting.
The multivariate Gaussian distribution and Gaussian graphical models.
Directed acyclic graphs, factorisation. Paths, d-separation, moralisation. Ancestral sets and sub-models. Decomposable models as intersection of directed and undirected models.
Running intersection property, Junction trees; message passing, computation of marginal and conditional probabilities, introduction of evidence. Gibbs sampling.
Causal models, structural equations, interventions, constraint-based learning, faithfulness. The trek rule and back-door adjustment.

Reading
S.L. Lauritzen, *Graphical Models*, Oxford University Press, 1996
T. Hastie, R. Tibshirani and J. Friedman, *Elements of Statistical Learning*, 2nd edition, Springer 2009 (available for free at https://statweb/stanford.edu/~tibs/ElemStatLearn/).
D. Koller and N. Friedman, *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009
J. Pearl, *Causality,* 3rd edition, Cambridge University Press, 2013
M.J. Wainwright and M.I. Jordan, Graphical Models, Exponential Families, and Variational Inference, *Foundations and Trends in Machine Learning*, 2008 (available for free at https://people.eecs.berkeley.edu/~wainwrig/Papers/WaiJor08_FTML.pdf)

SM10 Actuarial Science – 16 lectures MT

Synopsis
Fundamental nature of actuarial work. Use of generalised cash flow model to describe financial transactions. Time value of money using the concepts of compound interest and discounting.
Interest rate models. Present values and accumulated values of a stream of equal or unequal payments using specified rates of interest. Interest rates in terms of different time periods. Equation of value, rate of return of a cash flow, existence criteria.
Single decrement model. Present values and accumulated values of a stream of payments taking into account the probability of the payments being made according to a single decrement model. Annuity functions and assurance functions for a single decrement model. Risk and premium calculation.
Liabilities under a simple assurance contract or annuity contract.
Theories of value, St Petersburg Paradox, statement of Expected Utility Theory (EUT) and Subjective Expected Utility (SEU) representation theorems.
Risk aversion, the Arrow-Pratt approximation, comparative risk aversion, classical utility functions.

First and second order stochastic dominance, the Rothschild-Stiglitz Proposition.
Mossin's Theorem, static portfolio choice. Consumption and saving. Felicity Function and Prudence. Time consistency. Desynchronisation.

Reading
Subject CT1 Financial Mathematics Core Reading Institute & Faculty of Actuaries.
Subject CT5, Contingencies Core Reading, Institute & Faculty of Actuaries.
J.J. McCutcheon and W.F. Scott, *An Introduction to the Mathematics of Finance*. Heinemann, 1986.
P. Zima and R.P. Brown: *Mathematics of Finance*. McGraw-Hill Ryerson, 1993.
N.L. Bowers et al, *Actuarial mathematics,* 2nd edition, Society of Actuaries, 1997.
J. Danthine and J. Donaldson: *Intermediate Financial Theory*. 2nd edition, Academic Press Advanced Finance, 2005.
H.U. Gerber: *Life Insurance Mathematics*. 3rd edition, Springer, 1997.
L. Eeckhoudt, C. Gollier and H.Schlesinger, *Economic and Financial Decisions under Risk*, Princeton University Press Princeton and Oxford, 2005, Chapters 1-4, 10-11.
C. Gollier, *The Economics of Risk and Time*, MIT Press, 2001, Topics in chapters 1-4, 20.
Subject CT8: Financial Economics Core reading, Faculty & Institute of Actuaries, Units (i), (iii), (v)-(vi).

SM11 Stochastic Models in Mathematical Genetics – 16 lectures MT

Aims & Objectives
The aim of the lectures is to introduce modern stochastic models in mathematical population genetics and give examples of real world applications of these models. Stochastic and graph theoretic properties of coalescent and genealogical trees are studied in the first eight lectures. Diffusion processes and extensions to model additional key biological phenomena are studied in the second eight lectures.

Synopsis
Evolutionary models in Mathematical Genetics:
The Wright-Fisher model. The Genealogical Markov chain describing the number ancestors back in time of a collection of DNA sequences.

The Coalescent process describing the stochastic behaviour of the ancestral tree of a collection of DNA sequences. Mutations on ancestral lineages in a coalescent tree. Models with a variable population size.

The frequency spectrum and age of a mutation. Ewens' sampling formula for the probability distribution of the allele configuration of DNA sequences in a sample in the infinitely-many-alleles model. Hoppe's urn model for the infinitely-many-alleles model.

The infinitely-many-sites model of mutations on DNA sequences. Gene trees as perfect phylogenies describing the mutation history of a sample of DNA sequences. Graph theoretic constructions and characterizations of gene trees from DNA sequence variation. Gusfield's construction algorithm of a tree from DNA sequences. Examples of gene trees from data.

Modelling biological forces in Population Genetics: Recombination. The effect of recombination on genealogies. Detecting recombination events under the infinitely-many-sites model. Hudson's algorithm. Haplotype bounds on recombination events. Modelling recombination in the Wright-Fisher model. The coalescent process with recombination: the ancestral recombination graph. Properties of the ancestral recombination graph.

Introduction to diffusion theory. Tracking mutations forward in time in the Wright-Fisher model. Modelling the frequency of a neutral mutation in the population via a diffusion process limit. The generator of a diffusion process with two allelic types. The probability of fixation of a mutation. Genic selection. Extension of results from neutral to selection case. Behaviour of selected mutations.

Reading

R. Durrett, *Probability Models for DNA Sequence Evolution*, Springer, 2008
A.Etheridge, Some Mathematical Models from Population Genetics. Ecole d'Eté de Probabilities de Saint-Flour XXXIX-2009, Lecture Notes in Mathematics, 2012
W. J. Ewens, *Mathematical Population Genetics,* 2nd Ed, Springer, 2004
J. R. Norris, *Markov Chains*, Cambridge University Press, 1999
M. Slatkin and M. Veuille, *Modern Developments in Theoretical Population Genetics*, Oxford Biology, 2002
S. Tavaré and O. Zeitouni, *Lectures on Probability Theory and Statistics, Ecole d'Eté de Probabilities de Saint-Flour XXXI - 2001*, Lecture Notes in Mathematics 1837, Springer, 2004

SM13 Algorithmic Foundations of Learning – 16 lectures MT

Aims & Objectives

This course is meant to provide a rigorous theoretical account of the main ideas underlying machine learning, and to offer a principled framework to understand the algorithmic paradigms being used, involving tools from probability, statistics, and optimisation in high-dimension.

Synopsis

- Statistical learning frameworks for prediction, estimation and online learning.
- Probability
    - Maximal inequalities.
    - Rademacher and Gaussian complexities.
    - Elements of VC theory.
    - Covering and packing numbers.
    - Chaining.
    - Concentration inequalities.
- Statistics
    - Bayes decision rules.
    - Empirical risk minimisation. Error decomposition: generalisation, optimisation, and approximation.
    - Learning via uniform convergence, margin bounds, and algorithmic stability.
    - Structural regularisation: constrains and penalisation.
    - Implicit/algorithmic regularisation.
    - Convex loss surrogates.
    - Slow and fast rates.
    - Minimax lower bounds and hypothesis testing.
- Optimisation
    - Elements of convex theory.
    - Oracle model. Gradient descent. Mirror descent.
    - Stochastic oracle model. Stochastic gradient descent. Stochastic mirror descent. Variance reduction techniques.
    - Approximate Message Passing.

    - Online optimisation.
- Examples
    - Linear predictors, including Boosting.
    - Non-linear predictors, including Support Vector Machines and Neural Networks.
    - High-dimensional estimators for sparse and low-rank problems, including Lasso.
    - Online learning, including multi-armed bandit problems and algorithms.

Reading
Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014.
Sébastien Bubeck. Convex Optimization: Algorithms and Complexity. Foundations and Trends in Machine Learning, 2015.
Ramon van Handel. Probability in High Dimension. Lecture notes available online (http://www.princeton.edu/~rvan/APC550.pdf), 2016.
Tor Lattimore and Csaba Szepesvári. Bandit Algorithms. Book available online http://downloads.tor-lattimore.com/book.pdf), 2018.

2.6.2 Examination Paper II *Further Statistical Methodology*

CORE TOPICS

SM2 Computational Statistics – 13 lectures HT

Two non-assessed practicals, and Trinity Term assessed practical.

Synopsis
Smoothing methods (local polynomials). Nonparametric inference (bandwidth and Generalised Cross Validation).
Multivariate smoothers and Generalised Additive Models.

Inference using simulation methods. Monte-Carlo Tests. Permutation tests. Rank statistics.

Bootstrapping.

Hidden Markov Models: specification. Forward-backward algorithm. Kalman filter.

Reading
J. D. Gibbons, *Nonparametric Statistical Inference*, Marcel Dekker, 1985, pp 1-193, 273- 290.
G.H. Givens and J.A. Hoeting, *Computational Statistics*, 2nd edition, Wiley, 2012.
G. James, D. Witten, T. Hastie, R. Tibshirani, *An Introduction to Statistical Learning*, Springer, 2013. This book is freely available online: http://www-bcf.usc.edu/~gareth/ISL/
R. H. Randles and D. A. Wolfe, *Introduction to the Theory of Nonparametric Statistics*, Wiley 1979, pp 1-322.
L. Wasserman, *All of Nonparametric Statistics*, Springer, 2005.
L. Wasserman, *All of Statistics*, Springer, 2004.

Further reading
A.C. Davison and D.V. Hinkley, *Bootstrap Methods and their Application,* CUP, 1997.
C.R. Shalizi, *Advanced Data Analysis from an Elementary Point of View*, http://www.stat.cmu.edu/~cshalizi/ADAfaEPoV/.

SM4 Statistical Machine Learning 16 lectures HT

One non-assessed practical and one assessed practical

Aims and Objectives
Machine learning studies methods that can automatically detect patterns in data, and then use these patterns to predict future data or other outcomes of interest. It is widely used across many scientific and engineering disciplines.

This course covers statistical fundamentals of machine learning of machine learning, with a focus on supervised learning and empirical risk minimisation. Both generative and discriminative learning frameworks are discussed and a variety of widely used classification algorithms are overviewed.

Synopsis
Visualisation and dimensionality reduction: principal components analysis, biplots and singular value decomposition. Multidimensional scaling. K-means clustering.
Introduction to supervised learning. Evaluating learning methods with training/test sets.
Bias/variance trade-off, generalisation and overfitting. Cross-validation. Regularisation.
Performance measures, ROC curves. K-nearest neighbours as an example classifier.
Linear models for classification. Discriminant analysis. Logistic regression. Generative vs Discriminative learning. Naïve Bayes models.
Decision trees, bagging, random forests, boosting.
Neural networks and deep learning.

Reading
C. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007.
T. Hastie, R. Tibshirani, J Friedman, *Elements of Statistical Learning*, Springer, 2009.
K. Murphy, *Machine Learning: a Probabilistic Perspective*, MIT Press, 2012.

Further Reading
B. D. Ripley, *Pattern Recognition and Neural Networks*, Cambridge University Press, 1996.
G. James, D. Witten, T. Hastie, R. Tibshirani, *An Introduction to Statistical Learning*, Springer, 2013.

SM6 Bayes Methods – 16 lectures HT

Two non-assessed practicals, one assessed practical

Synopsis
Theory: Decision-theoretic foundations, Savage axioms. Prior elicitation, exchangeability. Bayesian Non-Parametric (BNP) methods, the Dirichlet process and the Chinese Restaurant Process. Asymptotics, information criteria and the Bernstein-von Mises approximation.

Computational methods: Bayesian inference via MCMC; Estimation of marginal likelihood; Approximate Bayesian Computation and intractable likelihoods; reversible jump MCMC.

Case Studies: extend understanding of prior elicitation, BNP methods and asymptotics through a small number of substantial examples. Examples to further illustrate building statistical models, model choice, model averaging and model assessment, and the use of Monte Carlo methods for inference.

Reading
C.P. Robert*, The Bayesian Choice: From Decision-Theoretic Foundations to Computational Implementation*, 2nd edition, Springer, 2001

Further Reading
A. Gelman et al*, Bayesian Data Analysis*, 3rd edition, Boca Raton Florida: CRC Press, 2014
P. Hoff, *A First Course in Bayesian Statistical Methods*, Springer, 2010.
DeGroot, Morris H., *Optimal Statistical decisions*, Wiley Classics Library, 2004.

OPTIONAL TOPICS

SM8 Advanced Topics in Statistical Machine Learning – 16 lectures HT

Aims and Objectives
Machine learning is widely used across many scientific and engineering disciplines to construct methods to find interesting patterns and to predict accurately in large data sets.
This course introduces several widely used data machine learning techniques and describes their underpinning statistical principles and properties. The course studies both unsupervised and supervised learning and several advanced topics and covered in detail, including some state-of-the-art machine learning techniques. The course will also cover computational considerations of machine learning algorithms and how they can scale to larger datasets.

Synopsis
Convex optimisation and support vector machines. Loss function. Empirical risk minimisation.
Kernel methods and reproducing kernel Hilbert spaces. Representer theorem. Representation of probabilities in RKHS.
Nonlinear dimensionality reduction: kernel PCA, spectral clustering.
Probabilistic and Bayesian machine learning: mixture modelling, information theoretic fundamentals, EM algorithm, Probabilistic PCA. Variational Bayes. Laplace Approximation.
Collaborative filtering models, probabilistic matrix factorisation.
Gaussian processes for regression and classification. Bayesian optimisation.
(+Latent Dirichlet allocation [if time allows]).

Software
Knowledge of Python is not required for this course, but some examples may be done in Python.
Students interested in learning Python are referred to the following free University IT online courses, which should ideally be taken before the beginning of the course:
https://help.it.ox.ac.uk/courses/overview

Reading
C. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2007.
K. Murphy, *Machine Learning: a Probabilistic Perspective*, MIT Press, 2012.

Further reading
T. Hastie, R. Tibshirani, J Friedman, *Elements of Statistical Learning*, Springer, 2009.
Scikit-learn: *Machine Learning in Python*, Pedregosa et al., JMLR 12, pp2835-2830, 2011,
http://scikit-learn.org/stable/tutorial/

SM12 Advanced Simulation Methods – 16 lectures HT

Aims & Objectives
The aim of the lectures is to introduce modern simulation methods.
This course concentrates on Markov chain Monte Carlo (MCMC) methods and Sequential Monte Carlo (SMC) methods. Examples of applications of these methods to complex inference problems will be given.

Synopsis
Classical methods: inversion, rejection, composition.

Importance sampling.

MCMC methods: elements of discrete-time general state-space Markov chains theory, Metropolis-Hastings algorithm.

Advanced MCMC methods: Gibbs sampling, slice sampling, tempering/annealing, Hamiltonian (or Hybrid) Monte Carlo, Pseudo-marginal MCMC.

Sequential importance sampling.

SMC methods: nonlinear filtering.

Reading
C.P. Robert and G. Casella, *Monte Carlo Statistical Methods*, 2nd edition, Springer-Verlag, 2004

Further reading
J.S. Liu, *Monte Carlo Strategies in Scientific Computing*, Springer-Verlag, 2001

SM14 Topics in Computational Biology – 16 lectures HT

Aims & Objectives
Modern molecular biology generates large amounts of data, such as sequences, structures and expression data that needs different forms of statistical analysis and modelling to be properly interpreted. This course focuses on four topics within this vast area: Molecular Dynamics, Molecule Enumeration, Comparative Biology and Overview of Computational Biology and Computational Neurosciences.

Synopsis
Overview of Computational Biology and Computational Neuroscience - Computational Biology is a very large and diverse field: Basically all the fields of biology where computation has started to be essential. Computational Neuroscience is in massive growth, but has a history going back to the 1940s with publications like McCullogh and Pitts (1943) paper on neural networks. The present progress is driven by progress on three fronts: (i) Experimental data on brains, nerve systems and individual neurons, (ii) increased success in designing artificial neural networks with an increasing variety in architectures with applications in Deep Learning/AI and (iii) the simulate very complex models as models of biological neural networks.

Molecular Dynamics (MD) – MD is another huge application area that describes the dynamics of molecules with few to thousands of atoms, for very short time periods like microseconds to nanoseconds. MD is bound to continue to grow for decades, and stochastic methods are central in exploring a large configuration space. The lectures are in Hamiltonian Dynamics; the canonical distribution and stochastic differential distributions, the Langevin model for Brownian motion and comparison of MD trajectories.

Molecule Enumeration – How many molecules are possible with a given number of atoms, from the set of carbon/nitrogen/phosphorus/oxygen/sulphur (CNPOS)? This question is central in drug design and has many statistical problems embedded. Exhaustive enumeration is at present limited to molecules with 18 CNPOS atoms, and including one more atom expands the numbers about a factor of 10-100 at this point. But there are many other possible avenue such as sampling or exploring a subspace generated by an initial set of molecules and a set of reactions. There are many advanced issues in counting molecules such Polya Counting and imposing constraints making molecular graphs embeddable in 3D.

Comparative Biology – Phylogenetics and comparative genomics have been the important areas of the last 15-20 years as a consequence of the growth to sequence data. However, there are other levels of data and biological organisation that are as least as interesting: protein structures, networks, shapes, movements. The lectures include models of evolution of these data types; the so-called COMPARATIVE MODEL; and simultaneous modelling of several levels.

Reading
The teaching material from 2018 would be useful to browse, but the 2019 will have some change in syllabus and improvements:
https://heingroupoxford.com/learning-resources/topics-in-computational-biology/

Further reading
M. Steel, Phylogeny: Discrete and Random Processes in *Evolution*, chapt 1-2, SIAM Press (2003).
T. Schlick, *Molecular Modeling and Simulation*. Chapt 13-14, Springer (2010).
M. Meringer "Structure Enumeration and Sampling" chapt. 8 in *Handbook of Chemoinformatics Algorithms* (eds Faulon) (2010). Chapman and Hall.
B.C. O'Meara Evolutionary Inferences from Phylogenies: A Review of Methods, *Annu. Rev. Ecol. Evol. Syst.* 2012. 43:267–85

2.6.3 Non-examined Material

There are a number of courses which will not be formally examined:

- *Case Studies in Statistical Science*
- *Introduction to LaTeX.*
- *Report writing*
- *Dissertation preparation*

Case Studies in Statistical Science
Students will take turns presenting a summary and critique of a piece of published statistical reasoning in weekly case-studies sessions. This will be run in the format of a journal club moderated by a member of faculty. Students will receive feedback on their presentations both in public (through questions and comments of a technical nature) and informally at the end in a short informal 'debrief'. As well as providing an opportunity for students to develop and practice their presenting skills, the presentations will help students revisit some of the material that has been covered in lectures and expose them to current issues in statistical research.

3. Teaching and Learning

3.1 Organisation of teaching and learning

The courses offered are listed in Section 2.4, and the terms in which these courses are given are in Section 2.5. The syllabus for these courses, together with the number of lectures, assessed and non-assessed practicals, are given in Section 2.6. Most courses have lectures, associated supervised practical sessions and/or problems classes. In addition, students will be expected to undertake reading, and work on practical preparation and problem sheets.

You should do all 3 core courses, plus 1 optional course, in each of Michaelmas and Hilary Terms. The core courses are "core" in the sense that you are required to do assessed practicals on most of these courses, and the material in core courses can be assumed known in other courses and for projects. You can attend additional optional courses if you wish. But studying an additional course seriously would be considerable extra work so you should consider this carefully when planning your work (you may want to discuss this point with your supervisor). Most students are expected to do 4 courses per term.

Information about practicals, problems classes, supervision, and projects, are given in Sections 3.2-3.5 below.

If you have issues with teaching or supervision, please raise these as soon as possible so that they can be addressed promptly. Details on whom to contact are provided in the section on complaints and appeals.

3.2 Practical classes and assessment

There are weekly practical classes, usually on Fridays. **The practical classes are compulsory and all students must attend them.** They will take place in LG.02.

Most classes will use R. The practical assessment is made up of a week-long assignment in Trinity Term and the assessment of specific pieces of coursework in Michaelmas and Hilary Terms. The assignments in Michaelmas and Hilary Terms are normally based on exercises done in the weekly practical classes. The submission times of the assessed practicals will be made available on the practical timetable and on the Weblearn calendar. The week-long practical assessment in Trinity Term took place from Friday week 0 to Monday week 2 in 2018. The assessment comprises a number of exercises involving the analysis of datasets. A complete report is required at the end of the assessment period. For each practical report that you submit, you should include the R code that you used as an appendix to your report. Sample solutions will be provided for each practical, whether assessed or not. Exercise sheets will be made available to the students in advance of each practical session.

There will be one practical assessed by group work in Hilary Term. An individual mock practical is held at the beginning of Michaelmas Term. You will receive feedback on this mock practical before undertaking any assessed practical. You will also receive feedback on assessed practicals you do in Michaelmas and Hilary Terms, using a form similar to that on the following page. The feedback given should be helpful before you do further assessed practicals later in the year. There will not be feedback on the Trinity Term week-long practical assessment as that is the final practical assessment in the final term of the course, but instead your overall assessed practical mark will be published (together with your exam marks) following the June/early July examiners meeting.

For the group work assessed practical, students will be allowed to choose their own groups. Because students will form their own groups, in exceptional circumstances smaller groups will be allowed. Each group is expected to submit a group report and each student in the group will receive the same mark for the group report.

All assessed practicals must be submitted via the WebLearn site. Students will be given instruction on how to do this at the beginning of Michaelmas Term. Students must keep a copy of the practical. Practicals will be blind marked and students will be issued with a **practical identification number** to use on their reports instead of names. Students should pay particular attention to the University's policies on plagiarism including collusion **www.ox.ac.uk/students/academic/guidance/skills/plagiarism/** and will be required to complete a declaration of authorship for each piece of coursework submitted.

Interim marks, given for the assessed practical assignments in Michaelmas and Hilary terms, are provisional and may be subject to further moderation. These interim marks are not numeric. Each piece of work will be given an overall level which will be one of "distinction", "good pass", "pass", "borderline pass/fail", or "fail". The assessed practicals contribute 25% to the overall mark for the MSc and 37.5% for the PG Diploma. Penalties will be imposed for late submission of practical reports without permission of the MSc Course Coordinator (who may consult the departmental Teaching Committee if permission for late submission is requested).

Where permission for late submission has not been granted, the normal penalties based on a submission deadline of Wednesday 12 noon are as follows:

Lateness	Mark penalty
Up to 2 hours, i.e. up to Wednesday 14:00	1 mark
2-5 hours, i.e. up to Wednesday 17:00	5 marks
5-24 hours, i.e. up to Thursday 12:00	10 marks
24-48 hours, i.e. up to Friday 12:00	15 marks
48-53 hours, i.e. up to Friday 17:00	20 marks
Over 53 hours, i.e. after Friday 17:00	25 marks

The mark penalty above would be deducted from the practical mark, when the practical mark is expressed out of 25. For example, if a student submits a practical report 4 hours late, and that report in itself is worth 17 marks (out of 25), then the penalty above means that s/he loses 5 marks and so the final mark is 12 (out of 25). The final mark cannot be negative, it is truncated at zero if necessary.

Further information on writing up practicals and the marking guidelines can be found on the course Weblearn site.

MSc/PG Diploma in Statistical Science
PRACTICAL FEEDBACK FORM

Student Name:
Practical Title:

[Tick one box for each of 1-6. The middle box corresponds to satisfactory work (and boxes to the right/left indicate stronger/weaker work).]

1. Writing Style	Unclear, difficult to read						Clear, flowing, easy to read
2. Statistical Analysis	Weak, invalid						Strong, valid
3. Answering the report question	Aspects of the question ignored						Question answered in full
4. Conclusions	No observations						Limitations of current analysis clearly brought out
5. Figures and Tables	No statistical meaning, wrong size, missing labels or captions						Meaningful, correct size, good labels and captions
6. R Code	Missing R code, inconsistencies						Well presented and correct R code

Overall Assessment:

[This indication is provisional and may be reviewed and amended by the Examiners.]

Individual Feedback:

3.3 Problems classes

Most courses, but not all, have problems classes as well as practicals. Problems classes are based around exercise sheets set by the lecturer and provide an opportunity to discuss solutions to some problems and to ask questions. Like non-assessed practical assignments, the exercises on problem sheets are also non-assessed.

3.4 Supervision

Each student is allocated a departmental supervisor. Your supervisor will arrange regular meetings with you during the year to discuss your progress. Supervisors will normally be supervising several students and it is usual that supervisors will see their students together as a group. Students must attend scheduled meetings with their supervisor. It is essential to keep these appointments and if, for good reason, you cannot make a meeting then you must let your supervisor know the situation in advance, for example by phone or email.

Supervisors might meet with their students up to four times a term. Each student should see his or her supervisor at the beginning of each term to arrange convenient times. Supervisors may be able to provide general academic advice, but it is important to note that supervisors are not expected to be expert in every subject covered by the MSc. For specific queries about a particular course the main contact point is the lecturer, not the departmental supervisor.

In addition to providing general advice, supervisors may be able to advise students about where to look (within Oxford, or outside) to find an answer to a question. If the question concerns some general aspect about being a student in Oxford then although the supervisor may not be able to answer the question themselves, they may be able to advise if there is somewhere in the University, or in the student's College, that could help.

In the rare event of any dissatisfaction with supervision, a student should contact the Course Coordinator or the Director of Studies to discuss changing supervisor.

3.5 The MSc dissertation project

MSc students are required to submit a dissertation of no more than 12,000 words. The dissertation project is mainly carried out over the summer period from early June to the dissertation submission date of noon on the second Monday in September.

Dissertations can be carried out on a variety of statistical topics. They are generally supervised by members of the Department. Students are welcome to suggest their own topics and should discuss their ideas with potential supervisors or with the MSc Course Co-ordinator.

Students are encouraged to propose their own projects. Students wishing to do this should start getting in touch with prospective supervisors at the beginning of, or early, in Hilary Term. Sometime during Hilary Term, perhaps about the middle of the term, students wishing to suggest their own project will need to submit the title and a brief statement of the form and scope of their project, together with the name of the person who has agreed to act as their supervisor for the dissertation. Alternatively, the Department also provides a list of possible projects from which students can state their preferences. This list may be available at the end of Hilary Term or early in Trinity Term. Students cannot be guaranteed to be allocated to a particular project on the list, the department will do its best to match student preferences to the projects available. All preferences submitted by the deadline for submission of preferences will be treated equally.

Students will usually be able to maintain contact with the project supervisor during at least part of the summer. The supervisor of the project will usually not be the departmental supervisor.

The dissertation is expected to include evidence that a student is capable of applying statistical research methods to realistic problems. Most dissertations will therefore contain an account of the analysis of some body of real data. Students are expected to find out most things by themselves by independent reading. Students should expect a maximum of six meetings in which progress is discussed, and for the supervisor to read one or two drafts of the dissertation. Please be reasonable, and allow a week or so for work to be read; this is particularly important in planning final writing.

The project is 25% of the MSc, it corresponds to approximately 3 months of full-time work, so is unlikely to be compatible with any summer internship (unless the internship involves doing MSc project work and has been approved in advance).

It is not the supervisor's job to undertake computer programming for the student, and it is not part of the department's function to provide detailed advice on statistical programming. Courses are provided to give students sufficient background, and students are expected to be able to write R functions for the project. It is a student's responsibility when choosing a project to ensure that the computing needed is within the skills they feel able to learn. There may be rare projects of a computational nature in which the supervisor agrees **in advance** to provide specialist software development and possible access to other resources.

Students should normally expect to use the computers in LG.02 for their dissertation project work. Projects should be designed to ensure they can be completed in a reasonable time using a desktop computer in LG.02, rather than requiring access to compute servers or HPC clusters which are not available. If you find your project solution is too big or too slow on a desktop computer, it is probably time to review how you are solving the problem, rather than searching for a bigger computer. Students who believe they need to use more than one desktop computer or wish to leave a computer running unattended, should discuss this in advance with the IT staff (please email ithelp@stats.ox.ac.uk).

Students may examine selected dissertations from previous years in the Statistics library. These dissertations are for reference only and **must not** be removed from the library. Some dissertations are also available on the course WebLearn site.

The dissertation should be typed and soft bound. Computer output should not be presented without pruning and annotation where necessary. The R code should appear in the appendix of the dissertation and will not be part of the word count.

The dissertation should include:

1) The title page
   Title, author, college and year of submission. Include the following at the bottom of the page, "A dissertation submitted in partial fulfilment of the requirements for the degree of Master of Science in Statistical Science". No logo is required.
2) An abstract
3) Acknowledgements
4) A contents page
5) A bibliography

The style of writing should be appropriate for a scholarly work: colloquialisms should be avoided. The dissertation must be carefully proof-read.

Candidates should make every effort to provide the appropriate references relating the work to the scientific literature, both in the subject matter under investigation and for the statistical and any other techniques used. References to published papers should be made carefully, with format similar to that used in standard journals. Particular emphasis should be given to the statistical aspects of the problem but the dissertation should show evidence of a reasonable understanding of the non-statistical features of the problem (e.g. the reasons for a particular scientific study).

In marking dissertations, the assessors will use the following criteria and weightings:

Criterion	Weighting	Poor Fail (<35)	Fail (35<39)	Borderline (40-49)	Pass (50-59)	Good MSc Pass (60-69)	Distinction (70-79)	Strong Distinction (80+)
STRUCTURE Understanding of aims Quality of general approach	10%	Hardly any understanding shown Serious lack of organisation	Major failings in understanding, but some things right. Poor organisation.	Sensible but inadequate, perhaps with substantial errors.	A fairly good grasp of issues. Perhaps some errors.	A good grasp of issues. An efficient business-like approach.	A very good grasp of issues. High quality.	An excellent grasp of issues. Exceptionally good quality.
LITERATURE AND THEORY Quality of scrutiny of literature Understanding of relevant theory	10%	Seriously inadequate use of literature. Significant gross misunderstanding.	Shallow use of literature. Major failings in understanding, but some things right.	Adequate but very unambitious pursuit of literature. Some substantial failings in understanding.	Modest initiative shown. A fairly good grasp of issues.	A good study of the literature. A good grasp of issues.	A very good study of the literature. A very strong grasp of the issues.	Excellent, ambitious, inspired, meticulous.
EXPOSITION Quality of exposition of source materials Quality of elaborations of source materials Quality of mathematical argument	20%	Seriously incoherent. No attempt to fill gaps.	Very poor exposition. Elaborations very sketchy or insufficient. Substantial defects in mathematical arguments.	Uninspired and unambitious but with some sensible attempts.	Generally fairly clear and coherent exposition. Some initiative shown. Mathematical arguments mostly sound.	A mostly clear exposition, with clear indications of thought and initiative.	A strong and clear exposition, with thought and initiative.	Excellent, with clear indications of outstandingly good thought and initiative.
METHODOLOGY Appropriateness of choice of techniques Quality of data-collection and/or handling Quality of computer work Accuracy	30%	Gross carelessness. Seriously incorrect techniques. Very serious misunderstanding of computer output.	Careless. Poor and/or ill-considered approaches. Significant misunderstanding of computer output. Serious inaccuracy.	Unambitious and lacking in thought. Perhaps several errors.	Generally sound. Perhaps occasional errors.	Sound and well organised. Appropriate and accurate.	High quality.	Exceptionally assiduous, and of a very high quality throughout.
CONCLUSIONS Appropriateness of conclusions drawn Understanding of implications and limitations	20%	False conclusions. Lack of comprehension of relevant issues.	Poor attempts at drawing conclusions. Poor understanding of relevant issues.	Mainly logical and sensible but uninspired and with clear weaknesses.	Generally sound, with modest evidence of thought.	Thoroughly appropriate. Providing evidence of good understanding.	Very good insights.	Exceptionally good insights.
PRESENTATION Clarity of style Quality of diagrams and tables Proper referencing to the literature	10%	Seriously unclear or muddled expression. Seriously defective graphics and/or tables. Seriously inadequate referencing.	Poor expression. Unclear logic. Very sketchy referencing.	Variable clarity. Satisfactory individual items but insufficient of them. Poor referencing.	Generally clear. Generally sound. Satisfactory referencing.	Clear. Sound. Good referencing.	Very clear, high quality.	Excellent in all regards, meticulous.

The length of the dissertation should be no more than is required to present the project in a satisfactory manner and in any case **no more than 12,000 words**. Inordinately lengthy dissertations may lose marks. There is no lower word limit, normally dissertations are between 8,000 and 12,000 words. The R code used, appropriately pruned, should be included as an appendix to the dissertation. It will not contribute towards the word count.

Two copies of the soft-bound dissertation are to be submitted to the Examination Schools, High Street, **by noon on 9 September 2019.** In the same envelope, a **PDF version of the dissertation**, on CD or USB stick, identical to the hard copy, must also be submitted. The examiners intend that the electronic copy of your dissertation will be screened by Turnitin for plagiarism.
A declaration of authorship form must also be completed and submitted with the dissertation.

Details of submitting work to the Examination Schools can be found at
www.ox.ac.uk/students/academic/exams/submission

Students should pay particular attention to the University's policies on plagiarism www.ox.ac.uk/students/academic/guidance/skills/plagiarism/.

Late submission of MSc dissertations will normally result in the following penalties.

Where permission for late submission has been granted by the Proctors, no penalty will be imposed.

Where permission for late submission has not been granted by the Proctors, the normal penalties based on a submission deadline of Monday 12 noon are as follows:

Lateness	Cumulative mark penalty
Up to 4 hours, i.e. up to Monday 4 pm	1
4-24 hours, i.e. up to Tuesday 12 noon	10
24-48 hours, i.e. up to Wednesday 12 noon	20
48-72 hours, i.e. up to Thursday 12 noon	30
72-96 hours, i.e. up to Friday 12 noon	35
96 hours-14 days	35
More than 14 days late	Fail

The penalty above would be deducted from a dissertation mark out of 100. For example, if a student submits a dissertation 22 hours late, and that dissertation in itself is worth 68 marks, then the 10 mark penalty above means that the final mark is 58. Subtracting the above penalty cannot reduce a mark below 40, the final mark would be truncated at 40 if necessary (if the initial mark was below 40, the final mark would be the initial mark). [The value 40 is the minimum dissertation mark for which an MSc pass is possible provided the other passing conditions are satisfied.]

Note that where permission for late submission has not been granted by the Proctors, a dissertation that is more than 14 days late results in an automatic Fail of the dissertation, and hence of the MSc.

Note that late submission of the dissertation may result in the Examiners deferring consideration to the following year.

Students will receive feedback on their dissertation using the form on the following page.

MSc in Statistical Science
DISSERTATION FEEDBACK FORM

Student Name:

Academic Year:

Dissertation Title:

[Tick one box for each of 1-6. The middle box corresponds to satisfactory work (and boxes to the right/left indicate stronger/weaker work). See also Section 2 of the Course Handbook for further explanation and for the weightings of criteria 1-6 below.]

1. Structure	Serious lack of organization						A very good grasp of issues
2. Literature and Theory	Inadequate use of literature						Very good, meticulous
3. Exposition	Seriously incoherent, no attempt to fill gaps						Very clear showing outstandingly good thought and initiative
4. Methodology	Careless, poor approaches						Assiduous and of a very high quality throughout
5. Conclusions	Lack of comprehension of relevant issues						Exceptionally good insights
6. Presentation	Unclear, defective graphics and/or tables, inadequate referencing						Clear, excellent quality and meticulous in all regards

Final Mark:

MSc in Statistical Science

DECLARATION OF AUTHORSHIP

Please submit the completed form with your dissertation.

Name (in capitals): Candidate number:

College (in capitals): Supervisor:

Title of dissertation (in capitals):

Word count:

Please tick to confirm the following:

I have read and understood the University's disciplinary regulations concerning conduct in examinations and, in particular, of the regulations on plagiarism (The University Student Handbook Section 8.8; available at https://www.ox.ac.uk/students/academic/student-handbook). ☐

I have read and understood the Education Committee's information and guidance on academic good practice and plagiarism at http://www.ox.ac.uk/students/academic/guidance/skills?wssl=1 ☐

The dissertation I am submitting is entirely my own work except where otherwise indicated. ☐

It has not been submitted, either partially or in full, for another qualification of this University (except where the Special Regulations for the subject permit this), or for a qualification at any other institution. ☐

I have clearly signalled the presence of all material I have quoted from other sources, including any diagrams, charts, tables or graphs. ☐

I have clearly indicated the presence of all paraphrased material with appropriate references. ☐

I have acknowledged appropriately any assistance I have received in addition to that provided by my supervisor. ☐

I have not copied from the work of any other candidate. ☐

I have not used the services of any agency providing specimen, model or ghostwritten work in the preparation of this dissertation. (See also section 2.4 of Statute XI on University Discipline under which members of the University are prohibited from providing material of this nature for candidates in examinations at this University or elsewhere: http://www.admin.ox.ac.uk/statutes/352-051a.shtml). ☐

I agree to retain an electronic version of the work until the publication my final examination result. I agree to make any such electronic copy available to the examiners s should it be necessary to confirm my word count or to check for plagiarism. ☐

Candidate's signature: Date: ……..

……..

3.6 Expectations of study and student workload

Students are responsible for their own academic progress.

The MSc course is full-time, students are expected to work 35-40 hours per week. The course lasts a year, so this is the expected amount of work each week during the whole year, so includes term-time weeks and also weeks during the vacation. Of course you can take some time off (holiday) during the year, say about 6 weeks' worth. You can choose how to schedule your time out of term, but you should not be expecting to take time off during term-time (nor just before/after term when there are scheduled MSc activities in week 0 or 9). After the exams (late May approx.) until early/mid-September you should be working on your project and dissertation.

During Michaelmas and Hilary Terms you are likely to have lectures to attend most days, possibly every day, and in most weeks you will have a practical session and one or more problems classes to attend. There is a Case Studies session most weeks, and a variety of one-off sessions, for example: an introduction to LaTeX and a couple of Report Writing sessions in Michaelmas Term, feedback sessions following assessed practicals in Michaelmas and Hilary Terms, a session introducing MSc projects in Hilary Term, etc. In a typical day you might attend a couple of lectures, a practical/problems class, and from time-to-time a one-off session – this is given as a guide only and timetables will vary between different students depending on the options taken. In addition to taking one optional course in each of Michaelmas and Hilary Terms, you are welcome to attend as many other optional lectures as you wish, though this would increase your workload. You can discuss this point, and points about how to manage your workload, with your supervisor.

Most students find that the time periods around assessed practicals are busy. The practical assignment will be available about a week before the submission deadline and should take a maximum of about 16-20 hours' work. There is certainly enough time in this period to schedule your work on the assessed practical, but you will probably want to plan carefully. Lectures, possibly some problems classes etc., will continue during these periods and you are expected to attend these in the usual way (one-off sessions will normally be scheduled to avoid assessed practical periods).

The time each week not covered by formal teaching sessions is for your own independent study on MSc course material. At times this will be studying the material covered in a lecture before the next lecture, attempting questions on a problem sheet ahead of a scheduled problems class, preparing for or working on an assessed practical assignment, and so on. In a normal week during Michaelmas and Hilary Terms, perhaps about a third of your time would be in spent in teaching sessions, the rest in independent study. In Trinity Term, following the week-long practical assessment in week 1, the 2nd, 3rd and 4th weeks of the term will have few, probably no scheduled activities to allow you to concentrate on exam revision. Most weeks out of term will not have any organised sessions, your working time in those weeks would be independent study, or working on your project over the summer period.

The University's policy on undertaking paid work whilst studying can be found at **www.admin.ox.ac.uk/edc/policiesandguidance/policyonpaidwork/**

4. Assessment

4.1 Assessment structure

General University information on examinations can be found at:
www.ox.ac.uk/students/academic/exams

There are two written examination papers:

Paper (i)	Principles of Statistical Analysis
Paper (ii)	Further Statistical Methodology

For MSc candidates the overall assessment is based on:

1. Paper I Principles of Statistical Analysis
2. Paper II Further Statistical Methodology
3. Assessed Practical Work
4. Dissertation.

Each of (1)–(4) has equal weight, i.e. each contributes 25% to the overall MSc assessment.

The assessed practical work (3) will be made up of practical assignments in Michaelmas Term and Hilary Term and a week-long practical assessment in Trinity Term. The relative weightings of the practical assignments are as follows:

practical assessments in Michaelmas and Hilary Terms	66.7%
practical assessment in Trinity Term	33.3%

Indications of marks given for the practical work in Michaelmas and Hilary Terms are provisional.

Candidates can pass, pass with merit, pass with distinction or fail. In order to pass, a candidate must achieve an average of at least 40% on (1) and (2), a mark of at least 40% on (4), and an overall average of at least 50% on (1) –(4). An overall average of at least 70% is required for a distinction together with a mark of at least 65% in the dissertation. In addition to satisfying the conditions for a pass, an overall average of at least 65% is required for a merit. Candidates who have initially obtained a mark of less than 50% on any of (1)-(4) shall not normally be eligible for the award of distinction or merit. Any candidate who does not meet the requirements to pass, fails the MSc. Any candidate who just fails the MSc can be allocated a pass on the PG Diploma if they show, in the view of the examiners, understanding and competence equivalent to passing the PG Diploma.

For Postgraduate Diploma candidates the overall assessment is based on:

1. Paper I Principles of Statistical Analysis
2. Paper II Further Statistical Methodology
3. Assessed Practical Work

Candidates can pass, pass with distinction, or fail. In order to pass, a candidate must achieve an average of at least 40% on (1) and (2), weighted in the proportion 3:2, and an overall average of at least 50% on (1), (2) and (3), weighted in the proportion 3:2:3. An overall average of 70%, weighted in the proportion 3:2:3, is required for a distinction. Candidates who have initially obtained a mark of less than 50% on any of (1)-(3) shall not normally be eligible for the award of distinction.

4.2 Examination conventions

Examination conventions are the formal record of the specific assessment standards for the course to which they apply. They set out how your examined work will be marked and how the resulting marks will be used to arrive at a final result and classification of your award. They include information on: marking scales, marking and classification criteria, scaling of marks, progression, resits, use of viva voce examinations, penalties for late submission, and penalties for over-length works.

The full Examination Conventions are approved by the departmental Teaching Committee in Michaelmas Term 2018 and are posted on the MSc and PG Diploma WebLearn site at **https://weblearn.ox.ac.uk/portal/site/:mpls:stats:msc2018**

4.3 Course regulations and syllabus

The regulations for the course can be found in the University of Oxford *Examination Regulations,* **https://www.admin.ox.ac.uk/examregs/**.
The *Examination Regulations* should be consulted for regulations concerning conduct of examinations and general regulations for graduate students. The *Lecture Synopses* defines the detailed content of the course for each year.

4.4 Feedback on learning and assessment

Students can obtain feedback on their learning in the following ways.

Formative assessment:

- Completing the summer review exercises before course starts and comparing their work with the solutions provided at the start of Michaelmas Term
- Written feedback form on the mock assessed practical in Michaelmas Term
- Feedback from coursework supervisor during supervision meetings in Michaelmas/Hilary/early Trinity Term
- Completing non-assessed practical assignments, and assessed practicals, and comparing their work with material provided by the lecturer
- Completing problem sheets before problem classes and comparing their work with solutions from classes
- Week 0 Hilary term test ('collection') and comparing their marked answers with the specimen solutions
- Completing relevant past exam questions and comparing their answers with the specimen solutions available in the department
- Feedback from project supervisor during project supervision meetings
- Feedback from project supervisor on draft dissertation (possibly during project supervision meetings)

Summative assessment:

- Written feedback forms on the assessed practicals done in Michaelmas and Hilary terms
- Exam results on Papers I and II, and overall assessed practical mark, published following the June/early July examiners meeting
- Dissertation result published in October
- Feedback form on dissertation distributed following the October examiners meeting.

Students are strongly advised to work through past papers to familiarise themselves with the form of the examinations. Past examination papers can be found in WebLearn online at **https://weblearn.ox.ac.uk/portal/site/:oxam**. Copies of outline solutions to some examination papers are available via the MSc WebLearn site **https://weblearn.ox.ac.uk/portal/site/:mpls:stats:msc2018**

Past examiners' reports on the examinations are also available via the MSc WebLearn site.

4.5 Entering for University examinations

The written examinations will be held in Trinity Term either at the Examination Schools in the High Street or Ewert House in Summertown. The dates, times and place will be available at **www.ox.ac.uk/students/exams/timetables/** nearer the time. The examinations are provisionally set to start on 27 May 2019.

As the two examination papers and assessed practicals, and dissertation (MSc only) are compulsory, there is no entry form to be completed.
The examiners may summon any candidate for an oral examination, but rarely do so.

4.6 Sitting your examination

Information on (a) the standards of conduct expected in examinations and (b) what to do if you would like examiners to be aware of any factors that may have affected your performance before or during an examination (such as illness, accident or bereavement) are available on the Oxford Students website **www.ox.ac.uk/students/academic/exams/guidance**.

Students requiring alternative examination arrangements should refer to the guidance at **www.ox.ac.uk/students/academic/exams/arrangements.**

Calculators, statistical tables and bilingual dictionaries
During the written examinations, electronic calculators may be used.

The examiners have issued a list of calculators approved for use in the examination papers for the MSc in Statistical Science and PG Diploma in Statistical Science. Candidates may use and calculator from the:

Casio fx-83 series;
Casio fx-85 series;
Sharp EL-531 series.

The Cambridge Elementary Statistical Tables will also be provided. These are available for viewing from 9 am – 12 noon, Monday-Friday, week 4, Trinity Term in the Department of Statistics. Bilingual dictionaries, in book form only, may be used in the examination if required by candidates. These must not be marked in any way or contain any notes etc.

4.7 Examiners and assessors

There are three or four internal examiners and one external examiner appointed each year to examine the MSc and Postgraduate Diploma in Statistical Science. The internal examiners are members of the Department of Statistics. One will act as the Chair of Examiners. The names of the examiners for 2018/2019 are listed on the Examination Conventions, published in Michaelmas Term. Assessors, who are usually the course lecturers, will be appointed to mark examination scripts. A number of members of the Department of Statistics will also be appointed as assessors to mark the dissertations.

Communication between examiners and candidates
Prior to the examinations, the Examiners will send out a notice to candidates outlining the examination arrangements. This will also be posted on the MSc WebLearn site.

The results for Postgraduate Diploma students will be known after the Examiner's Meeting which takes place a few weeks after the examination. The results for MSc students are known in mid-October following submission of the dissertation in mid-September. The Examiners will release the final mark for each exam paper and for the assessed practical work after the June/July Examiners' meeting. After the Examiners meeting in June/July for the Postgraduate Diploma, or October for the MSc, students should log on to Student Self Service at **www.ox.ac.uk/current_students** to obtain their final results.

Students are not permitted to contact the internal Examiners, external examiner or the Assessors directly on any matter related to the examinations. Queries on examination matters should be directed to College Advisors, Departmental Supervisors or the Academic Administrator as appropriate. If you are unhappy with an aspect of your assessment you may make a complaint or appeal (see page 39).

Resitting examinations
If the examiners decide that the standard of a candidate's work is not sufficient to qualify for the MSc but sufficient to qualify for the Postgraduate Diploma in Statistical Science, the candidate is given the option of re-taking the MSc examination on one further occasion, not later than one year after the initial attempt, or of being issued with a Post Graduate Diploma. In the event of a candidate's work not being sufficient to qualify for the award of the MSc, the examiners will specify which of the components of the course may or must be redone. The results following a resit examination may only be available in October of the year in which the resit examination was held.

4.8 Gutierrez Toscano Prize

The Gutierrez Toscano Prize, value £150, may be awarded by the examiners, if there is a candidate of sufficient merit, to the candidate whose performance in that examination they judge to be the best.

The prize is named in memory of Pablo Gutiérrez Toscano, who was awarded a distinction in the MSc in Applied Statistics in 1996. In 1998 he was tragically killed in a road accident. His family and friends offered a donation to establish the annual prize.
www.stats.ox.ac.uk/student-resources/msc-in-statistical-science/gutierrez-toscano-prize/

4.9 Academic Integrity and the avoidance of plagiarism

Academic integrity

The University's code of practice concerning academic integrity in research is set out on the website at **www.admin.ox.ac.uk/personnel/cops/researchintegrity/**, and, while the code's principles relate specifically to the conduct of research, *all* graduate students are advised to make themselves aware of the document's contents. The University code of practice on Public Interest Disclosure can be found at **www.admin.ox.ac.uk/personnel/cops/pid/**.

Plagiarism

University Definition – see **www.ox.ac.uk/students/academic/guidance/skills/plagiarism**
Plagiarism is presenting someone else's work or ideas as your own, with or without their consent, by incorporating it into your own work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition. Plagiarism may be intentional or reckless, or unintentional. Under the regulations for examinations, intentional or reckless plagiarism is a disciplinary offence.

Cases of suspected plagiarism in assessed work are investigated under the disciplinary regulations concerning conduct in examinations. **Intentional or reckless plagiarism may incur severe penalties, including failure of your degree or expulsion from the university.**

Why does plagiarism matter?

It would be wrong to describe plagiarism as only a minor form of cheating, or as merely a matter of academic etiquette. On the contrary, it is important to understand that plagiarism is **a breach of academic integrity**. It is a principle of intellectual honesty that all members of the academic community should acknowledge their debt to the originators of the ideas, words, and data which form the basis for their own work. Passing off another's work as your own is not only poor scholarship, but also means that you have failed to complete the learning process. Deliberate plagiarism is unethical and can have serious consequences for your future career; it also undermines the standards of your institution and of the degrees it issues.

What forms can plagiarism take?

- **Verbatim quotation of other people's intellectual work without clear acknowledgement.** Quotations must always be identified as such by the use of either quotation marks or indentation, with adequate citation. It must always be apparent to the reader which parts are your own independent work and where you have drawn on someone else's ideas and language.

- **Paraphrasing the work of others by altering a few words and changing their order**, or by closely following the structure of their argument, is plagiarism because you are deriving your words and ideas from their work without giving due acknowledgement. Even if you include a reference to the original author in your own text you are still creating a misleading impression that the paraphrased wording is entirely your own. It is better to write a brief summary of the author's overall argument in your own words than to paraphrase particular sections of his or her writing. This will ensure you have a genuine grasp of the argument and will avoid the difficulty of paraphrasing without plagiarising. You must also properly attribute all material you derive from lectures.

- **Cutting and pasting from the Internet.** Information derived from the Internet must be adequately referenced and included in the bibliography. It is important to evaluate carefully all material found on the Internet, as it is less likely to have been through the same process of scholarly peer review as published sources.

- **Collusion.** This can involve unauthorised collaboration between students, failure to attribute assistance received, or failure to follow precisely regulations on group work projects. It is your responsibility to ensure that you are entirely clear about the extent of collaboration permitted, and which parts of the work must be your own.

- **Inaccurate citation**. It is important to cite correctly, according to the conventions of your discipline. Additionally, you should not include anything in a footnote or bibliography that you have not actually consulted. If you cannot gain access to a primary source you must make it clear in your citation that your knowledge of the work has been derived from a secondary text (e.g. Bradshaw, D. *Title of book*, discussed in Wilson, E., *Title of book* (London, 2004), p. 189).

- **Failure to acknowledge.** You must clearly acknowledge all assistance which has contributed to the production of your work, such as advice from fellow students, laboratory technicians, and other external sources. This need not apply to the assistance provided by your tutor or supervisor, nor to ordinary proofreading, but it is necessary to acknowledge other guidance which leads to substantive changes of content or approach.

- **Professional agencies**. You should neither make use of professional agencies in the production of your work nor submit material which has been written for you. It is vital to your intellectual training and development that you should undertake the research process unaided.

- **Autoplagiarism**. You must not submit work for assessment which you have already submitted (partially or in full) to fulfil the requirements of another degree course or examination.

The necessity to reference applies not only to text, but also to other media, such as computer code, illustrations, graphs etc. It applies equally to published text drawn from books and journals, and to unpublished text, whether from lecture handouts, theses or other students' essays. You must also attribute text or other resources downloaded from web sites.

Cases of apparently deliberate plagiarism are taken extremely seriously, and where examiners suspect that this has occurred, they bring the matter to the attention of the Proctors. Your attention is drawn to the Proctors' and Assessor's Memorandum, Section 9.5, 'Conduct in Examinations', and in particular to sections 4 and 5 and the concluding paragraph of the section:

4 No candidate shall present for an examination as his or her own work any part or the substance of any part of another person's work.

5 In any written work (whether thesis, dissertation, essay, coursework, or written examinations) passages quoted or closely paraphrased from another person's work must be identified as quotations or paraphrases, and the source of the quoted or paraphrased material must be clearly acknowledged.

The University employs software applications to detect plagiarism in submitted examination work, both in terms of copying and collusion. It regularly monitors on-line essay banks, essay-writing services, and other potential sources of material. It reserves the right to check samples of submitted essays for plagiarism. Although the University strongly encourages the use of electronic resources by

students in their academic work, any attempt to draw on third-party material without proper attribution may well attract severe disciplinary sanctions.

5. Skills and Learning Development

5.1 Academic progress

Each term students are strongly encouraged write a short report on their progress on the Graduate Supervision Reporting (GSR). GSR can be accessed through Student Self Service at https://www.ox.ac.uk/students/selfservice. GSR is open for student reporting in weeks 7-9. From week 10 onwards each term, the supervisor is responsible for writing a report about the student on GSR. Reports can be viewed by the student, supervisor, MSc Course Co-ordinator, Director of Graduate Studies and College Advisor.

Responsibility for an individual student's progress is usually taken by the supervisor, but the MSc Co-ordinator and the Academic Administrator will also monitor progress of all students on the course. The reports from students and supervisors on the Graduate Supervision Reporting (GSR) each term are also read and commented on by the Director of Graduate Studies. Unsatisfactory progress will also usually lead to discussion with appropriate college officers.

Students are always welcome at any time to discuss their concerns with their departmental Supervisor, the MSc Course Co-ordinator, the Director of Studies, the Director and Deputy Director of Graduate Studies, the Head of Department or the Academic Administrator as appropriate.

5.2 Learning development and skills

Students are encouraged to attend the Statistics Graduate Lecture series and Departmental seminars as appropriate and also to attend talks organised by some of the research groups that may be of particular interest. In addition to the assessed course on Statistical Programming, there are lectures on report writing (for practical reports, and for dissertations), and LaTeX document preparation, specifically for MSc students.

A wide range of information and training materials are available to help students develop their academic skills – including time management, research and library skills, referencing, revision skills and academic writing – though the Oxford Students website
www.ox.ac.uk/students/academic/guidance/skills.

All Masters students within the MPLS Division automatically become a member of the Mathematical, Physical and Life Sciences (MPLS) Division Graduate School when they register for a postgraduate level qualification here. Through the Graduate School, students can view and book training provided by all MPLS departments as well as the Division, Bodleian Libraries, Careers Service, IT Services and Language Centre. **www.mpls.ox.ac.uk/training**

The Department of Statistics organises a distinguished speaker seminar series, usually on Fridays at 3.30 pm, which students are encouraged to attend. Further information can be found at **www.stats.ox.ac.uk/news-events/**.
Students are also welcome to attend the Graduate Lectures, which take place on Thursday afternoons several times a term.

Other seminar series may be of interest to particular students. Supervisors will be able to offer advice.

University Language Centre
International students, whose first language is not English, are strongly advised to visit the University Language Centre to find out more about the courses on topics such as Academic Writing and Advanced Communication Skills which run during term time. These have a registration fee for graduate students. Details are available at **www.lang.ox.ac.uk/courses/english.html .**

5.3 Induction

In 0th week of Michaelmas Term, the week before the full undergraduate term begins, students are provided with an induction programme which includes familiarisation with the Department's library and a tour of the Radcliffe Science Library; setting up Departmental computer accounts and familiarisation with the practical facilities; a separate talk about the University's computing facilities and training courses; meetings with the Head of Department, the Director of Studies, the MSc Co-ordinator and Academic Administrator.

5.4 The Careers Service

The University Careers Service can be found at 56 Banbury Road with a website at **www.careers.ox.ac.uk/.** It is a free service for all Oxford University students including postgraduates, and also for alumni. It provides one to one guidance, support and advice; information on occupations, vacancies and further study, feedback on CVs and application forms; and skills coaching for preparing for interviews and making applications.

The Careers Service also runs the University Internship Programme **www.careers.ox.ac.uk/internship-office-and-work-experience/the-internship-programme/**.

Information about studying for a DPhil in Statistics at the University of Oxford can be found at **www.stats.ox.ac.uk/study-here/research-degrees/**

6. Student Representation, Evaluation and Feedback

6.1 Departmental representation

The MSc and Postgraduate Diploma students are invited to elect, soon after the beginning of the academic year, two representatives who can act as a link with the staff, and in particular bring to light and discuss any problems that might arise. The representatives will be invited to attend the Graduate Liaison Group which meets once a term in week 4.
See http://www.stats.ox.ac.uk/student-resources/research-degrees/graduate-liaison-group/

One of the representatives will also be invited to attend relevant meetings of the departmental Teaching Committee.

6.2 Division and University representation

Student representatives sitting on the Divisional Board are selected through a process organised by the Oxford University Student Union (Oxford SU). Details can be found on the Oxford SU website along with information about student representation at the University level.

6.3 Opportunities to provide evaluation and feedback

Feedback can be channelled through the informal meetings between supervisors and students, and the regular informal contact that students have with the MSc Course Co-ordinator and with the Academic Administrator.

At the end of each term students are invited to complete a short feedback questionnaire covering the lecture courses, practical sessions and supervisory sessions. We encourage students to complete and return these. All comments are anonymous. The overall results are discussed by the Teaching Committee, which will provide a summary and its response via WebLearn, and are important part of our quality assurance procedures as part of the continuing review and development of the course.

Students on full-time and part-time matriculated courses are surveyed once per year on all aspects of their course (learning, living, pastoral support, college) through the Student Barometer. Previous results can be viewed by students, staff and the general public at **www.ox.ac.uk/students/life/feedback**. Results from the Student Barometer survey are discussed by the departmental Teaching Committee.

7. Student Life and Support

7.1 Who to contact for help

Students are always welcome at any time to discuss their concerns with their departmental Supervisor, the MSc Course Co-ordinator, the Director of Studies, the Director and Deputy Director of Graduate Studies, the Head of Department, the Academic Administrator, or the MSc Administrator as appropriate. Support is also available via College Advisors and College Offices.

In case of illness or being otherwise unable to attend practical classes or lectures, students should contact the MSc Administrator. Where illness or other factors will prevent submission of assessed practical work on time, students must contact the MSc Course Co-ordinator in the first instance.

Every college has their own system of support for students. Please refer to your College handbook or website for more information on who to contact and what support is available through your college.

Details of the wide range of sources of support available more widely in the University are available from the Oxford Students website **www.ox.ac.uk/students/welfare,** including in relation to mental and physical health and disability.

Other sources of advice and help include:

Student Counselling Service	**www.ox.ac.uk/students/welfare/counselling/**
Oxford University Student Union	**http://ousu.org/advice/life-welfare/supportservices/**
Nightline	**http://users.ox.ac.uk/%7Enightln/**

Suspension of status or withdrawal from course
Should you find that you need to apply to suspend your status on the course or wish to withdraw, you should discuss this with the Course Co-ordinator and also your College Office or College Tutor. The relevant forms to be completed can be found at
www.ox.ac.uk/students/academic/graduates/forms/#d.en.7466 .

After the course
At the end of the course, students should ensure that they have returned all library books.
Students should contact their supervisor if a reference is required.

Information on academic transcripts can be found at
www.ox.ac.uk/students/graduation/transcripts. Students receive one copy of the final transcript automatically on completion of the degree. Further copies can be ordered.

You will receive an email with information about booking a degree ceremony. See
www.ox.ac.uk/students/graduation/ceremonies/ for further information.

Harassment
The Departmental advisors on matters of harassment are Ms Hannah Harrison (room G.11), tel. x82857, email **hannah.harrison@stats.ox.ac.uk** or Dr Neil Laws (room 1.04), tel. x72597, email **laws@stats.ox.ac.uk**. The University's *Policy on Harassment including Bullying* can be found at
www.admin.ox.ac.uk/eop/harassmentadvice/

Disability
The Disability Co-ordinator is Mrs Jan Boylan (room G.09, tel. x 72870, email **boylan@stats.ox.ac.uk .** The academic departmental Disability Lead is Dr Neil Laws (room 1.04), tel. x72597, email **laws@stats.ox.ac.uk**.

For University guidance and support please refer to **www.admin.ox.ac.uk/eop/disab/** and **www.ox.ac.uk/students/welfare/disability/.**

Childcare Services
Information on the University's childcare services can be found at
www.admin.ox.ac.uk/childcare/

Financial matters
Information on fees and funding matters can be found at
www.ox.ac.uk/students/fees_funding_living_costs/
Information on hardship funding can be found at

7.2 Complaints and academic appeals within the Department of Statistics

The University, the Mathematical, Physical and Life Sciences Division and the Department of Statistics all hope that provision made for students at all stages of their programme of study will make the need for complaints (about that provision) or appeals (against the outcomes of any form of assessment) infrequent.

Nothing in this guidance precludes an informal discussion with the person immediately responsible for the issue that you wish to complain about (and who may not be one of the individuals identified below). This is often the simplest way to achieve a satisfactory resolution.

Many sources of advice are available within colleges, within departments and from bodies like Student Advice Service provided by the Oxford University Students' Union (OUSU) or the Counselling Service, which have extensive experience in advising students. You may wish to take advice from one of these sources before pursuing your complaint.

General areas of concern about provision affecting students as a whole should, of course, continue to be raised through the Graduate Liaison Group or via student representation on the department's committees.

Complaints
If your concern or complaint relates to teaching or other provision made by the Department**,** then you should raise it with the Chair of the Teaching Committee (Dr Neil Laws) or Director of Graduate Studies (Professor Gesine Reinert) as appropriate. Within the department the officer concerned will attempt to resolve your concern/complaint informally.

If you are dissatisfied with the outcome, then you may take your concern further by making a formal complaint to the University Proctors. The procedures adopted by the Proctors for the consideration of complaints and appeals are described on the Proctors' webpage (**http://www.proctors.ox.ac.uk/complaintsandacademicappeals/**), the Student Handbook (**www.proctors.ox.ac.uk/handbook/)** and the relevant Council regulations (**www.admin.ox.ac.uk/statutes/regulations/247-062.shtml**).

If your concern or complaint relates to teaching or other provision made by your college, then you should raise it either with your college advisor or with the Senior Tutor or Tutor for Graduates (as appropriate). Your college will also be able to explain how to take your complaint further if you are dissatisfied with the outcome of its consideration.

Academic appeals
An appeal is defined as a formal questioning of a decision on an academic matter made by the responsible academic body.

For taught graduate courses, a concern which might lead to an appeal should be raised with your college authorities and the individual responsible for overseeing your work. **It must not be raised directly with examiners or assessors.** If it is not possible to clear up your concern in this way, you may put your concern in writing and submit it to the Proctors via the Senior Tutor of your college
As noted above, the procedures adopted by the Proctors in relation to complaints and appeals are described on the Proctors' webpage, the Student Handbook and the relevant Council regulations

Please remember in connection with all the academic appeals that:

(a) The Proctors are not empowered to challenge the academic judgement of examiners or academic bodies.
(b) The Proctors can consider whether the procedures for reaching an academic decision were properly followed; i.e. whether there was a significant procedural administrative error; whether there is evidence of bias or inadequate assessment; whether the examiners failed to take into account special factors affecting a candidate's performance.
(c) On no account should you contact your examiners or assessors directly.

7.3 Policies and regulations

The University has a wide range of policies and regulations that apply to students. These are easily accessible though the A-Z of University regulations, codes of conduct and policies available on the Oxford Students website **www.ox.ac.uk/students/academic/regulations/a-z.**

In particular your attention is drawn to the *Policy on recording lectures by students*. This policy is also available on the MSc WebLearn site and at **http://www.admin.ox.ac.uk/edc/policiesandguidance/.**

These policies also include:

University Equality Policy	**www.admin.ox.ac.uk/eop/policy/equality-policy/**
Code of conduct for using IT facilities	**www.it.ox.ac.uk/rules/**

8. Facilities

8.1 Social spaces and facilities

Facilities and provisions for making tea and coffee are available in the kitchen in the ground floor social area in the St Giles' building. Tea and instant coffee are free. There is also a bean to cup coffee machine, dispensing coffee and hot chocolate for a small charge. The fridges are kept stocked with milk, but otherwise are available for use for storage of small quantities of perishable food. Filtered chilled water is available using one of the zip taps. The microwave ovens can be used for heating food. Please keep the kitchens tidy.

Daily newspapers are available to read in the social area but should not be removed.
Please do not take food or drink into the IT Computing Lab or the Lecture Rooms.

Students are welcome to participate in the social and sporting activities of their college. Individual college websites give for further details about all aspects of college provision.

Graduate students may become members of the University Club in Mansfield Road, and participate in the range of sporting activities provided by the University.

8.2 Workspace

Each student works on an individual machine in LG.02, the IT teaching lab, during the scheduled supervised practical sessions, where there are demonstrators to give students guidance if necessary.

LG.02 is generally accessible 24 hours a day for MSc students to use, although it will sometimes be required for undergraduate teaching. A Linux and a Windows desktop are also available in the library. Wireless access is provided throughout the Department. The Department also has its own computing support team if there are problems with equipment or software.

8.3 Libraries

The Department has its own small library on the ground floor in the St Giles' building. Copies of each of the core books on the reading list for the MSc in Statistical Science can be found there. There is also some workspace available for students.

A current University card is required for registering and for entry to the library. The library door should be kept locked at all times. Only the Librarian or administrative staff may give access to non-members of the Department.

Most of the departmental books are catalogued on SOLO, the University's on-line catalogue. SOLO can be accessed through the library terminal. Links to the University's e-resources, including electronic journals can be found via SOLO.

The lending books are currently undergoing a process of re-shelving using Library of Congress classifications. Books are borrowed on a self-issue basis by scanning into the self-issue computer firstly the barcode from the reader's University card, and then the barcode sticker inside the front cover of the book to be borrowed. Each book borrowed **must be recorded** on the self-issue computer in the library. Stolen books have to be replaced, reducing the budget for new books. Reference books, dissertations and theses and any items without barcodes **cannot be borrowed**.

Books should be left in the **returns box** in the library. If books are overdue then reminder notices will be sent out by email. If a book is reserved by another reader or needs to be recalled then a reader may receive a notice, again by email.

Reservation requests can be made via SOLO, the University's library catalogue. Reserved books can be collected from Hannah Harrison in G.11.

MSc students can borrow up to 9 books for one week and then can be renew them on a further three occasions unless recalled by the library. Loans may be renewed either by using SOLO before the due date, by checking them out again, or by e-mailing lib@stats.ox.ac.uk
Replacement costs will be charged for lost, damaged or defaced books.

The library computers **must not** be unplugged or switched off.

Personal belongings should not be left unattended in the library at any time. Any such items will be removed. The Department will not be responsible for personal belongings which are stolen or damaged.

Photocopies may only be made in compliance with copyright law. Details are displayed by the Departmental printers/photocopiers.

The University Card also serves as a library card and will allow access to the Radcliffe Science Library (RSL) in Parks Road, and also the Social Studies Library, Manor Road. A map can be found **at www.ox.ac.uk/visitors/maps-and-directions/museums-libraries-and-places-of-interest.**
The Physical Sciences Librarian with responsibility for the statistics collection in the RSL is Ljilja Ristic (email **ljilja.ristic@bodley.ox.ac.uk**). A specific training session for statistics research is held in Hilary Term.

College libraries may also be useful although access is usually restricted to members of that college.

8.4 IT

The principal computing resource for the MSc is the IT Teaching Suite, LG.02. Students can use the Windows or Linux desktops to run software packages such as R, Python or MATLAB, as well as to prepare documents and reports. Network attached printers are available and some of these can also copy and/or scan documents to Oxford email addresses or individual USB storage.

The practical sessions will introduce students to the use of the departmental computing systems and to the main statistics packages. Other courses, particularly those on high-level programming languages, which are provided by the University's IT Services in Banbury Road may be of interest to students **www.it.ox.ac.uk/**. Project work in the summer will normally require the use of a computer. Please refer to the section on the dissertation for further information.

Individual photocopying/printing accounts are set up by the IT staff and full details will be provided in the introductory talks during first week.
A comb binding machine is available in LG.02. Please remember copyright law applies.

You should also make yourself aware of the following departmental documents:

Guide to Computing Services
Guidelines for Examining Users' Data

Security and Privacy of Files
Policy Statement on Computer Use, Monitoring and Surveillance.

These are available at
www.stats.ox.ac.uk/about_us/it_information/generalaccess/new_users_start_here along with details of how to use your laptop on the Oxford Wireless LAN.

8.5 Department of Statistics - General information

Access to 24-29 St Giles'
The Department's building at 24-29 St Giles' is accessible by the University card 24 hours a day, 7 days a week including bank holidays; administrative staff are on duty from 8.30 am to 5.00 pm (Monday to Friday).

Care of Buildings
As there is no caretaker for the building, we ask all users of the building to help with security. Please doors secure and follow the security notices. Please report any building problems needing attention to **building@stats.ox.ac.uk**.

Recycling is encouraged. Paper, cardboard, drinks cans, food tins, plastic bottles and marked plastic items (recycling types 1,2,3,5 or 6) should be put in the green topped recycling bins. All recyclables must be empty or rinsed out. No food or liquid should be put in the recycling bins. There is one bin for glass with a turquoise topped lid, please ensure that you use the correct bin.

Please avoid using the lift out of general office hours, if possible.

Post
Pigeonholes on the ground floor are appropriately marked for department members and graduate students.
University Messenger Service collects and delivers mail for the departments and colleges of the University. Items can be left for collection in the tray in Reception.

Telephones
Currently all telephones in public areas have access for internal University use and 999 calls only.

Lost property
Items which have been found are lodged at Reception. Uncollected items are disposed of at the end of each term.

Emergencies, security and safety

Fire:
Please read the blue fire-action notices posted in the buildings and familiarise yourself with the escape routes. If there is a fire emergency, immediately break the glass on the nearest fire alarm point and then call both Security Services (89999) and the Fire Brigade ((9)999). Operate extinguishers only if this does not put you at risk and otherwise vacate the building immediately.

On hearing the fire alarm ringing please leave the building immediately. **DO NOT** stop to pick up your belongings. The assembly point is on the corner of the Physics building in Keble Road. Do not re-enter the building until told by someone in authority that it is safe to do so. Someone in authority

means either the Head of Department, the Administrator, Deputy Administrator, or in their absence a fire officer.

Security:
Theft of personal items does occur from time to time. It is important to remain aware of this and help maintain the security of the buildings. Personal belongings should not be left unattended at any time.

The University Security Service can be reached by phone on 89999.

First Aid: lists of qualified First Aiders are posted on each floor and there is a First Aid Kit in the ground floor kitchen. Out of hours, please phone 89999 for first aid assistance. For an ambulance phone (9)999.

Fires, security alerts and serious accidents must be reported to the Administrator or Deputy Administrator and the scene of report must remain undisturbed.

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University of Oxford
24-29 St Giles'
Oxford
OX1 3LB

Tel: +44 1865 272860 (Reception)
Departmental web-site: **www.stats.ox.ac.uk/**

Emergency telephone numbers (from any phone) are:
UNIVERSITY SECURITY SERVICES: 89999
FIRE BRIGADE, AMBULANCE SERVICE, POLICE: (9) 999