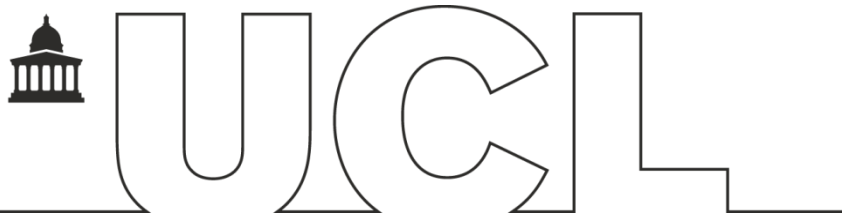
DEPARTMENT OF STATISTICAL SCIENCE



Taught Postgraduate Student Handbook

2017/18

DEPARTMENT OF STATISTICAL SCIENCE TAUGHT POSTGRADUATE STUDENT HANDBOOK

The *Department of Statistical Science Taught Postgraduate Student Handbook* has been written for postgraduate students admitted by the Department of Statistical Science to study for one of the following degrees:

MSc Data Science
MSc Statistics
MSc Statistics (Medical Statistics)

The contents also provide information that may be useful for postgraduate students studying Statistical Science as part of the following degrees:

MSc Computational Statistics and Machine Learning (known as CSML)
MSc Data Science and Machine Learning

However, students on these programmes should refer primarily to the corresponding information published by the Department of Computer Science at: http://www.cs.ucl.ac.uk/current_students/degree_programme/.

The *Department of Statistical Science Taught Postgraduate Student Handbook* is intended to provide particular information for students registered for the degrees listed above. General information about studying at UCL is given in the *Academic Manual* (http://www.ucl.ac.uk/srs/academic-manual/overview) and *Current Students* (http://www.ucl.ac.uk/current-students/) sections of the UCL website. It is important that you are aware of the contents of these sections of the UCL website.

The *Department of Statistical Science Taught Postgraduate Student Handbook* contains numerous hyperlinks to sources of further information. The corresponding URL for each hyperlink is not always written out in full, so if you are reading a printed copy of the handbook, you may need to refer to the electronic version available at: https://www.ucl.ac.uk/statistics/current/pghb.pdf in order to access all of the information that you require.

The information given in this handbook is as far as possible accurate at the date of publication, but the Department reserves the right to make amendments before the commencement of, or during, the courses to which it refers. Information concerning College regulations and procedures is given for guidance only and is not intended as a substitute for that contained in the UCL Academic Regulations and on the main UCL website (available from the web addresses above).

Department of Statistical Science, University College London, September 2017.

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The *Department of Statistical Science Taught Postgraduate Student Handbook* includes information on the following:

PROVOST'S WELCOME

Dear students

To those of you who are returning, welcome back. To those of you who are new, congratulations for choosing UCL as your university. Great minds don't think alike and the reasons for your choice will be unique to you. But there are certain features of a UCL education that are constant, whatever your programme.

Through our Connected Curriculum, we seek to give you the opportunity to learn by participating in research and enquiry at all levels of study. You will be stretched intellectually, your programmes enriched by world-leading researchers pushing the boundaries of knowledge. You will have access to excellent digital and physical learning resources as well as a taught curriculum that makes our graduates so employable.

This doesn't mean that your journey will be the same as everyone else's. You can shape UCL and your experience within it. Take our university-wide surveys and make your voice heard. Become a ChangeMaker or an Academic Representative and work in partnership with academics to make your programme of study even better.

You'll also have opportunities to learn outside your degree programme. Participate in our Global Citizenship Programme, exploring ways of addressing some of the world's most pressing challenges in the two weeks of summer term following exams. Get involved with amazing volunteering opportunities (coordinated by the Volunteering Services Unit) and make a difference locally. Investigate opportunities for entrepreneurship through UCL Innovation and Enterprise.

UCL is first and foremost a community of great minds. You are a valuable member of that community. I hope you will take every opportunity to shape your time here, so that your experience is the best possible.

Professor Michael Arthur
UCL President and Provost

DEPARTMENT OF STATISTICAL SCIENCE

The Department of Statistical Science is a constituent department of the Faculty of Mathematical and Physical Sciences (abbreviated to MAPS). Some information about the history of the Department is provided on the Departmental website.

The Department of Statistical Science is located on the first and second floors of 1-19 Torrington Place. The offices of the academic staff are all in this location. The Departmental Office can be found in room 120 on the first floor.

Staff

Academic staff

Prof RE Chandler (Head of Department)

Dr G Ambler	Dr G Baio	Dr JA Barber
Dr A Beskos	Dr C Cotar	Prof M De Iorio
Prof P Dellaportas	Prof T Fearn	Prof SE Guillas
Dr CM Hennig	Prof VS Isham	Dr FJ Király
Dr IN Kosmidis	Dr SJ Livingstone	Dr I Manolopoulou
Dr G Marra	Dr PJ Northrop	Dr AG O'Keeffe
Prof SC Olhede	Prof RZ Omar	Dr GW Peters
Dr Y Pokern	Prof AS Siddiqui	Dr RBA Silva
Dr ADL van den Hout	Dr HM Wilkinson-Herbots	Prof PJ Wolfe
Dr J Xue		

Teaching staff

Dr N Abourashchi	Dr A Donov	Dr SJ Harden
Dr J Herbert*	Dr TR Honnor	Dr EM Jones
Mrs K Krajniewska*	Dr MJ Rassias	

*members of staff indicated with an asterisk are based outside UCL

Support staff

Dr RG Evans	Ms C Ghosh	Mrs D Jayawardena Wilkinson
Ms KA Leport	Mr J Picken	Mr C Visavakul

Staff with particular responsibility for taught postgraduates

MSc Tutor

The MSc Tutor in the Department of Statistical Science is responsible for the day-to-day running of the three programmes listed at the top of page 1. The equivalent responsibility for the CSML and Data Science and Machine Learning programmes is held by Programme Tutors in the Department of Computer Science. However, the MSc Tutor in the Statistical Science Department acts as the Statistics Tutor to CSML and Data Science and Machine Learning students, whom they may consult about the Statistics courses in their degree programmes.

The MSc Tutor is **Dr C Cotar** (room 126, c.cotar@ucl.ac.uk).

Programme Administrator

The Programme Administrator works closely with the MSc Tutor and is the first point of contact for many aspects of your studies. For example, you should contact the Programme

Administrator to notify absence from college, to submit medical documentation or to change a module registration.

The Programme Administrator is **Ms C Ghosh** (room 120, chandrima.ghosh@ucl.ac.uk).

Personal Tutor

UCL is committed to providing all students with the academic guidance and personal support that they need to flourish as members of our active learning and research community. As part of the wider support infrastructure provided by a programme, every undergraduate student will be assigned a member of staff who can provide constructive academic and personal development guidance and support. At the start of the year, students will be provided with the name and identity of their Personal Tutor, the date of their first meeting, and where and when the Personal Tutor can be found in term time. Students are encouraged to be proactive in engaging with their Personal Tutor, as it is the responsibility of the student to keep in touch.

Your Personal Tutor's name is shown on your Portico record (see "Portico" section on page 9) and it is expected that it will be the same person throughout the whole of your degree programme.

Further information:

- Personal Tutors

If you become unhappy with your degree programme, or a particular course, or with your progress, or if you cannot cope, or if you have other problems, you should immediately discuss the matter with the MSc Tutor, Programme Administrator or your Personal Tutor. Such problems are often much simpler to deal with if they are addressed immediately. You will then be directed to an appropriate person for more specialist advice if that is necessary.

Other relevant staff roles

Careers Tutor:	Dr C Cotar (room 126)
Chair of Staff-Student Committee:	Dr SJ Harden (room 140)
Chair of Departmental Teaching Committee:	Dr J Xue (room 141)

Students' common room and departmental student society

Room 117 is the common room for all taught students registered in the Department of Statistical Science. All such students are eligible for membership of the student-run Statistics Society, which organises social and other activities. Any mail arriving in the Department addressed to taught students will be placed in the pigeonholes in the Students' Common Room.

Study facilities

Masters students have their own study room (the Postgraduate Study Room, room 123), which contains several PCs. This facility is managed by the Departmental Systems Administrator, **Mr C Visavakul** (room 132, c.visavakul@ucl.ac.uk). Students may also use the lecture room 102 for study when it is not being used for lectures or other classes and meetings.

Departmental opening hours are 08:00 to 19:00 on weekdays (Mondays to Fridays). Outside these hours postgraduate students still have access to the building via their entry/ID cards during 1-19 Torrington Place opening hours, which are 06:30 to 23:00 on

weekdays and 08:00 to 20:00 at weekends. Access to the Department outside normal office hours will require knowledge of the key-pad entry codes, which can be obtained from the Departmental Office. Please note that out-of-hours access is restricted to departmental rooms only and that the rest of the building (including the ISD computer cluster, room 113) will still close at 19:00.

There is substantial space for reading and studying in the College Library (see page 12).

How UCL and the Department will communicate with students

UCL will communicate with students via:

- UCL student email – Students should check their UCL email regularly.
- UCL Moodle – UCL's online learning space, used by module organisers, programme leaders, departments and faculties to provide essential information in addition to learning resources.
- myUCL – A weekly term-time e-newsletter to all students (undergraduate and postgraduate) at UCL, which covers key internal announcements, events and opportunities.
- UCL Instagram – UCL's official Instagram channel, featuring news, events, competitions and images from across the UCL community.
- @ucl Twitter channel – Sharing highlights of life at UCL from across UCL's diverse community.

Email

Email is used for communication throughout the College and you will be allocated an email address by UCL (see http://www.ucl.ac.uk/isd/services/email-calendar). Please check your UCL email account regularly. There may be urgent messages left for you, e.g. from Student and Registry Services, the Departmental Office, your Personal Tutor, or from staff teaching courses that you attend.

Your tutors, lecturers and College administrative staff will use your *College email address* and expect you to read and act promptly upon all messages sent to you at this address. If you wish to use only your own email address from a provider external to the College, then it is your responsibility to arrange for emails to be forwarded from your College email address. However, UCL cannot be held responsible for mail that is delayed or lost as a result of being forwarded to an external provider. *Any consequences arising from not acting upon emails to your College address rest with* ***YOU*****.**

DOSSSH

The Department maintains a Moodle space called the "Department of Statistical Science Student Home" (DOSSSH) to which all Statistical Science students have access. Please check the DOSSSH page regularly. The DOSSSH page contains notices about courses, examinations and other useful information about the Department, as well as downloadable forms and links to resources that are described elsewhere in this handbook.

Processing of personal information

Whilst you are a student at UCL, the College will need to store and communicate information about you. This section summarises UCL and Departmental procedures with respect to such information.

How UCL uses student data

UCL uses student information for a range of purposes connected with their studies, health and safety. UCL takes the protection of student information very seriously and complies with the Data Protection Act (DPA) 1988. Information about students will only be shared within UCL when necessary. UCL may also be required by law to share information with some external agencies for a variety of purposes, such as the Students' Union, the Higher Education Statistics Agency and UK Visas and Immigration. After students leave UCL their data is retained in the permanent archives.

Further information:

- UCL General Student Privacy Notice
- UCL Confidential Information Statement
- UCL Information Security Policies
- data-protection@ucl.ac.uk

Portico

Portico is the main UCL student information system which is used by all students for:

- Updating personal data such as addresses or contact numbers
- Completing online module registration
- Viewing information about programmes/modules
- Viewing examination timetables and results
- Pre-enrolment and re-enrolment
- Applying for graduation ceremonies

Further information:

- Portico login
- Portico Helpdesk

If you need a document that can be used to confirm your registration status at UCL, you can print out a Statement of Student Status letter or an opening a bank account letter via Portico. Just log into Portico and click on the Statement of Student Status link on your Portico home page. Alternatively you can send an email request to studentstatus@ucl.ac.uk with your name, student number, date of birth and desired delivery address. Please note that the Department will **NOT** issue certificates of student status or attendance.

It is your responsibility to ensure that your personal details held on the UCL central record are correct and up-to-date. This information can be viewed via Portico. Instructions on how to update your personal information can be found at: https://www.ucl.ac.uk/current-students/services_2/personal_information. *Any consequences arising from the failure to correct or update your personal information rest with **YOU**.*

Return of coursework

Marked coursework, bearing a grade, may be returned to you via your pigeonhole, in classes, or through the Departmental Office. These routes are not completely secure and may result in other students seeing your grade. If you are unhappy about this, you should discuss your concerns with the course tutor.

References

We need your explicit permission to give any reference for you. This applies to **ALL** references, (e.g. for a landlord, a prospective employer or a Masters degree programme). Thus, when you give either the Department's or a tutor's name as a referee, it is important that you complete and sign a "Reference Request" form confirming that you have done so.

The form is available from the Departmental Office and the DOSSSH Moodle page (see page 8).

CALENDAR OF EVENTS

UCL term dates

Terms for the 2017/18 session are based on the pattern of 12 weeks, 11 weeks and 7 weeks.

First Term	Monday 25 September 2017 – Friday 15 December 2017
Second Term	Monday 08 January 2018 – Friday 23 March 2018
Third Term	Monday 23 April 2018 – Friday 08 June 2018

For those departments that operate them, Reading Weeks are the weeks beginning Monday 06 November 2017 (term 1, week 7), and Monday 12 February 2018 (term 2, week 6).

Christmas College Closure	Close 17:30 Friday 22 December 2017
	Open 09:00 Tuesday 02 January 2018
Easter College Closure	Close 17:30 Wednesday 28 March 2018
	Open 09.00 Thursday 05 April 2018
Bank Holidays	Closed - Monday 07 May 2018
	Closed - Monday 28 May 2018
	Closed - Monday 27 August 2018

Further information:

- Term dates 2017/18

Final verification for student term 2 module choices

Student confirmation	Wednesday 06 December 2017
Department confirmation	Friday 15 December 2017

UCL examination periods

Main Exam Period	Wednesday 25 April – Friday 08 June 2018
Late Summer Exam Period	Monday 20 August – Friday 07 September 2018

Key dates

Term 1

- **Week 0:** All students have to carry out *College enrolment* and *module registration*. Further details concerning induction arrangements for new students are provided upon arrival at the Department.

  College enrolment is organised by Student and Registry Services, who send you information about the procedure before the start of the term. New students must complete enrolment in person when they arrive at UCL. Continuing students can re-enrol online.

  Module registration is done using the online Portico system (see “Portico” section on page 9). The procedure will be explained to you upon arrival (see also “Degree Programme Specifications” section on page 19). Tutorial groups are allocated automatically and your groups will appear in your online timetable (see “Timetable” section on page 11).

  Foundation Course: details are given to you on arrival at the Department.

- **Week 2:** Beginning of *lectures* for all courses in the Department of Statistical Science. Friday is the deadline for making term 1 *module amendments*.
- **Week 7:** This is *Reading Week.* Classes in the Department of Statistical Science are replaced by self-study activities, including some set by the course lecturers. *Not all departments observe reading week and you MUST attend classes given in other departments if they continue during this time.*
- **Week 11:** Wednesday is the deadline for making term 2 *module amendments*.
- **Week 12:** End of all term 1 *teaching* in the Department of Statistical Science.

Term 2

- **Week 1:** Beginning of *lectures* in the Department of Statistical Science. Students should check their online timetable for the term 2 tutorial arrangements, and also check for any other timetable changes that may have occurred.
- **Week 6:** This is *Reading Week*. Refer to the corresponding item in term 1 for details.
- **Week 11:** End of all *teaching* in the Department of Statistical Science.

Term 3

- **Week 1:** Some *revision classes* will be offered. Wednesday is the start of the *examination period*.
- **Week 7:** Friday is the end of the *examination period*.

Start of June to start of September

- Students work on their *project*, culminating in an oral presentation and submission of the final version of the dissertation at the start of September.
- For students who are required to *resit* elements of the taught component during the summer, these assessments will take place between 20 August – 7 September.

Courses not organised by the Department of Statistical Science may not follow the above schedule. For further information you should check with the relevant teaching department.

TEACHING AND STUDYING ARRANGEMENTS

Course System

Taught postgraduate programmes are made up of component courses. Most courses consist of lectures supplemented by at least one of the following: *tutorials, workshops, problem classes*. The proportions of these activities vary over courses; details for courses offered by the Department of Statistical Science are provided later in this handbook.

Timetable

The timetable for lectures, workshops and problem classes can be found at http://www.ucl.ac.uk/timetable. After making your module selections on Portico, tutorial allocation will be arranged by the relevant Teaching Administrator before courses start and your tutorial group will automatically appear in your online timetable. However, it may take one or two days after registration has been approved before all of the classes appear on your personal timetable, particularly for tutorials. Check your timetable frequently, in case alterations have been made. *Note also that, once allocated, your tutorial group will **NOT** be changed unless you can demonstrate a timetable clash.*

Although the timetable states that lectures (and other classes) begin and end on the hour, there is a College-wide agreement that this refers to a starting time of *5 minutes past the stated hour* and a finishing time of *5 minutes to the hour*. This should give you time to get to your next lecture before it is due to start.

Scheduled teaching and learning activities

Lectures

These are formal and can involve large groups, often including students from other degree programmes. Where possible, Statistical Science lectures take place in lecture rooms 102 and 115 in 1-19 Torrington Place. These rooms are too small for many of the larger courses, however, and therefore many Statistical Science lectures take place in other rooms around the College, as do lectures for other UCL courses.

Tutorials

Small group weekly tutorials are provided for some courses. These are less formal than lectures and enable you to raise your own questions about course material, as and when they arise from lectures or coursework.

Workshops

Workshops, also referred to as "practical classes" within the Department, involve doing set work under guidance from the course staff. Some workshops will take place in computer cluster rooms. You should take a pocket calculator to all workshops (see page 14 for guidelines regarding calculators).

Problem classes

These involve discussing coursework with the whole class.

Office hours

For courses offered by the Department of Statistical Science, each member of the academic and teaching staff should nominate at least one weekly office hour during term time in which they will be available to answer general queries arising from lectures, problem sheets, etc. If you need to consult a course lecturer, please do so in an office hour. *In particular, in the period leading up to any assessment (see "In-Course Assessment" section on page 29) the course lecturer will set aside a fixed time or times at which (s)he will be available to answer questions about the assessment. (S)he will **NOT** answer queries about the course outside these times until the assessment is over.*

For other courses, refer to the corresponding information published by the relevant teaching department.

Learning resources and key facilities

UCL Library Services

UCL has 19 libraries and a mixture of quiet study spaces, bookable study rooms and group work areas. Each library has staff that students can ask for help. The UCL Library Services page has information for students about using the library, services available, electronic resources and training and support.

- Library information for students

The Science Library (in the DMS Watson building, Malet Place) contains an exceptionally good collection of statistical science text and reference books. Copies of most books that

are highly recommended for courses taught by the Department are included in the Short Loan Collection on the ground floor in the Science Library. The Collection consists of all subjects of the Science Library and is arranged on open access shelves in one alphabetical sequence under authors. The period of loan for statistical science books is 2 days. Books cannot be taken out of the room without being issued. Other recommended books, for which there is less demand, are kept on the third floor of the Science Library. The loan period assigned to these is one week. There are longer loan periods for other books.

UCL Library Services has developed a set of online training materials, to help users find and use information effectively. Topics covered include finding materials in reading lists; search tips and techniques; accessing electronic resources; referencing; and copyright and plagiarism issues. Students taking project courses may also benefit from the more advanced "WISE for Built Environment, Engineering, Maths and Physical Sciences" course, accessible from https://www.ucl.ac.uk/library/training/guides.

A new graduate Research Grid was opened recently on the fourth floor of the Science Library. This can accommodate up to 74 graduate students and offers a variety of workstations and study spaces to suit individual study as well as collaborative social learning. The new learning space features a group meeting room, a private Skype point, student lockers, 24 all-in-one Desktop PCs and a hot water point for tea and coffee.

UCL Information Services Division (ISD)

The UCL Information Services Division (ISD), the primary provider of IT services to UCL, offers IT learning opportunities for students and staff in the form of 'How to' guides which provide step-by-step guidance to all of ISD's key services, including email and calendar services, user IDs and passwords, print, copy and scanning, wifi and networks. There are also opportunities for digital skills development through face-to-face training in areas such as data analysis, programming, desktop applications and more, along with individual support through drop-ins and via the ISD Service Desk. UCL also has a licence for Lynda.com which provides thousands of high quality video-based courses from programming to presentation skills. Learning on Screen provides students with access to an archive of 65 free-to-air channel programming for educational usage. In addition, Kanopy is available to UCL students, and offers a wide range of movies.

E-learning services available to students include Moodle, Turnitin and Lecturecast and allow students to access online course materials or take part in online activities such as group work, discussions and assessment. Students can re-watch some lectures using the Lecturecast service and may also use interactive tools in the classroom.

ISD provides desktop computers and laptops for loan in a number of learning spaces. A map of computer workrooms is available on the ISD website. Computers at UCL run a Desktop@UCL sevice which provides access to hundreds of software applications to support students. It is also possible to access a large range of applications remotely, from any computer, using the Desktop@UCL Anywhere service. Students also have access to a range of free and discounted software via ISD Software for Students.

All students are encouraged to download the UCL-Go app, available for iOS and Android devices. The app gives access to Moodle and timetabling and shows where desktop computers are available on campus.

UCL Centre for Languages & International Education (CLIE)

The UCL Centre for Languages & International Education (CLIE) offers courses in over 17 foreign languages (including English), along with teacher training courses, across a range of academic levels to support UCL students and staff and London's wider academic and professional community. CLIE provides degree preparation courses for international students, courses satisfying UCL's Modern Foreign Language requirements and a range of

UCL summer school courses. Students can also access a database of language-learning resources online through the CLIE Self-Access Centre, including film and documentary recommendations and books for self-study.

Further information:

- CLIE website
- CLIE Self-Access Centre

Moodle

Moodle is UCL's online learning space. It includes a wide range of tools which can be used to support learning and teaching. Moodle is used to supplement taught modules, in some cases just by providing essential information and materials, but it can also be integrated more fully, becoming an essential component of a module. Some modules may use Moodle to provide access to readings, videos, activities, collaboration tools and assessments.

All courses in the Department of Statistical Science have a presence on Moodle, and students registered for these courses can use the service to access online resources such as course information, lecture notes and assessment material. Students are given additional printing credits, to allow them to print copies of the lecture notes for each of their statistics courses.

Further information:

- Moodle
- Frequently Asked Questions
- Quick Start Guide

Calculators

There are eight calculator models that the College has approved for use in examinations. These are the Casio FX83ES, FX83GT+, FX83MS and FX83WA which are all battery powered, and Casio FX85ES, FX85GT+, FX85MS and FX85WA which are all solar powered. *Students on the degree programmes covered by this handbook may **NOT** use any other type of calculator in Statistical Science examinations***.** Students are therefore strongly advised to purchase one of these calculators at the start of their degree programme. The use of a non-approved calculator constitutes an examination irregularity (i.e. cheating) and carries potentially severe penalties.

Statistical tables

Statistical tables are provided by the College for use in all examinations set by the Department. The currently provided tables are *New Cambridge Statistical Tables* by D.V.Lindley & W.F.Scott. These will be the statistical tables referenced in the Department's courses.

Feedback on student work

Students receive feedback on all items of assessed coursework (see “Components of Compulsory Assessment” section on page 29) and on selected items of non-assessed work. Feedback may be given in tutorials, problems classes or electronically. It may take the form of verbal or written comments, either personalised or in the form of general points that emerged from the class as a whole. These comments are intended to help you see what was done well and where there is room for improvement. For assessed work, the comments are also provided to help justify the grade awarded.

For assessed work, feedback will include a *provisional* letter grade. The correspondence between letter grades and percentage marks, along with guidance regarding the interpretation of each grade, is as follows:

	Grade	Mark	Interpretation
Pass	A+	≥ 80	The criteria for an A grade are all met. Additionally, exceptional quality has been demonstrated with respect to at least two of the following: understanding, insight, depth of analysis or clarity of discussion, with evidence (where appropriate) of relevant knowledge or reading.
	A	70 to 79	The criteria for a B grade are all met, along with one or more of the following: high quality answers in a wide range of questions, evidence of a very sound understanding, thoroughness of discussion and clarity of expression, evidence of insight, wide knowledge or reading. There may be a small number of relatively minor errors or inconsistencies, but there should not be serious errors in knowledge or understanding.
	B	60 to 69	Good understanding of the questions asked, good knowledge of the main aspects of the subject and good levels of appropriate skills (such as the ability to carry out calculations and manipulations, and to develop a logical argument), along with a level of understanding appropriate to a Masters qualification. At the higher end of the range, one would expect to see clear expression and presentation. A few mistakes are allowable, providing they are not serious.
	C	50 to 59	Reasonable understanding of the subject (sufficient for a pass at Masters level) and a reasonable level of ability in the appropriate skills. At the lower end of this range, work may differ from scripts in the 46-49 range by showing a wider knowledge or having more convincing answers. At the higher end, work in this category may fail to reach Grade B either because it does not demonstrate a wide enough range of knowledge (e.g. some good answers, but too many questions or part questions either omitted or answered inappropriately), or because skill deficiencies lead to too many mistakes or badly presented answers.
Fail	D	40 to 49	Some limited understanding of the subject, but insufficient for a pass at Masters level. This grade might indicate, for example, a serious but largely unsuccessful attempt at a paper; or that some progress has been made but in an insufficient number of questions or at an insufficient level of analysis. It might also indicate answers that show some knowledge of the main concepts, definitions and terminology but are limited, for example, by errors or ambiguities in notation, or because their relevance to the question is not made clear.
	F	≤ 39	At the lower end of this scale, the answers will show little or no understanding of either the questions or the subject. At the higher end, a very limited understanding may be present, but answers will present little evidence of relevant knowledge and contain many mistakes, irrelevancies or misunderstandings. In practice, one might expect a mark at the lower end to indicate that a candidate has not made a serious attempt at answering the questions or who has practically no understanding of the subject; and a mark at the higher end to arise when questions have been attempted but the answers contain little of relevance.

Model answers

Many Statistical Science courses have regular sets of exercises. These are designed to help students learn and, in most courses, it is essential that students do the exercises in order to understand the subject. Course lecturers are often asked to provide model answers to the exercise sheets. There is a similar demand for model answers to past exam papers. Lecturers do provide model or outline answers to some exercises and to some exam questions, but it is Departmental policy not to do so in general, for a number of reasons:

- We do not want to encourage students to "learn answers" but rather to create a culture in which they know that they must work out the answer for themselves. Often it is not the answer, but the process of working it out that is the main learning experience.
- We are trying to encourage independent thought and understanding, so that students can answer (more or less well) different questions, similar questions in different forms, and to solve related problems. Understanding in statistical science, and in mathematics, comes much more from doing than from reading.
- It is important for students to learn how to persevere with a problem when they are "stuck". In the past, we have found that model answers handed out in one year are often passed on to students in a subsequent year, to the detriment of the learning process.

A common argument put forward by students is "Yes, we want to do the exercises, but we would like model answers in order to check that we have the right method and answer". Of course it can sometimes be helpful to look at answers, but it is also important to learn how to verify answers when they are not otherwise available, and to gain the confidence to know when you are right. One function of tutorials is to discuss problems or work through them with the teacher, and this is one way in which answers may be obtained. Part of the skill of the teacher is to help the student to progress without "spoon feeding" the answer.

Having said all of this, the Department recognises that while preparing for examinations in particular, it can be useful for students to have the final answers (rather than complete solutions) to past exam questions: this provides some confidence that the answers obtained while attempting past papers are correct. All teaching staff should provide such "final" answers routinely, for selected exam papers from 2015 onwards, via their course Moodle pages (see page 14).

WHAT IS EXPECTED OF STUDENTS

Student code of conduct

UCL enjoys a reputation as a world-class university. It was founded on the basis of equal opportunity, being the first English university to admit students irrespective of their faith and cultural background and the first to admit women. UCL expects its members to conduct themselves at all times in a manner that does not bring UCL into disrepute. Students should ensure they read and familiarise themselves with UCL's Student Code of Conduct and be aware that any inappropriate behaviour may lead to actions under UCL's Student Disciplinary Procedures.

Further information:

- UCL Student Code of Conduct
- Student Disciplinary Code and Procedure

Attendance requirements

UCL expects students to aim for 100% attendance, and has a minimum attendance requirement of 70% of scheduled learning, teaching and assessment activities. If a student does not meet this requirement they may be barred from summative assessment.

You are expected to be in attendance during the UCL terms throughout your programme of study. This includes reading weeks (see page 10). If you wish to be absent from College for some special reason, you should obtain permission *beforehand* from the MSc Tutor (see page 6).

If you have a good reason for needing to miss a compulsory class, you must inform the Programme Administrator and lecturer or tutor concerned in order to be excused. The Department keeps records of coursework submission and attendance at tutorials and workshops. At the end of each term, you will be required to explain an unsatisfactory attendance record to the Faculty Tutor. An inadequate explanation may lead to your studies being suspended.

You may also be taking some courses provided by other departments, where arrangements are likely to be different from those in the Department of Statistical Science. It is important that you know what is expected of you in each of these courses. *You may be barred from taking examinations if you have not attended enough tutorials or submitted enough coursework, **EVEN** if it does not count towards the final examination mark.*

The importance of attendance at lectures and other classes has been stressed above. Requests for special attention (e.g. for missed notes, handouts, problem sheets etc.) due to non-attendance without good reason (e.g. medical), do not create a good impression. The same applies to non-submission of coursework. Remember that when writing a job reference for you, we are usually asked to provide information about your attendance and punctuality, as well as your ability, etc. If you are absent from any lecture or other class, you should endeavour to copy up notes promptly.

Further information:

- Attendance Requirements
- Barring Students from Assessment

Tier 4 students: absence from teaching and learning activities

In line with UCL's obligations under UK immigration laws, students who hold a Tier 4 visa must obtain authorisation for any absence from teaching or assessment activities.

Further information:

- Authorised Absence
- UCL Visa and Immigration pages

Absence from assessment

Any student who is absent from an assessment must obtain authorisation for the absence by submitting a request for Extenuating Circumstances.

Further information:

- Extenuating Circumstances

Studying

Tutorials

Tutorials in the Department of Statistical Science are *compulsory* and provide the opportunity to get personal attention. It is important to prepare yourself by reading through the latest lecture material and trying the relevant exercises sheets *before the tutorial*. Think of questions relating to the course material to ask; make a note of points that you don't understand so that you can have them clarified in tutorials. Take your recent lecture notes and exercise sheets to each tutorial, in particular those relating to material that you know will be discussed.

Lectures, workshops and problem classes

Most new material is presented in lectures; some might be introduced by your trying ideas in workshops. The workshops give the opportunity to solve problems with guidance, a helpful alternative method of learning. In most courses learning is sequential; you need to have met and understood past material in order to follow the current material. You are therefore strongly advised to attend all classes. Teaching staff and demonstrators are able to give some personal attention in workshops; absences are likely to be noted.

Staff sometimes receive complaints from students about disruption and noise (caused by other students) in large classes. All students are respectfully asked to consider others when in the classroom: excessive noise and disruption can have a negative impact on the learning experience for everybody. Any student who is persistently disruptive will be asked to leave the classroom, and will receive an official warning from their Programme Tutor with an appropriate note placed on the student's record.

Coursework

In the Department of Statistical Science regular, often weekly, coursework is set. Some of this is for in-course assessment, but much of it is to help you to learn the material being taught. You will normally receive feedback from coursework during problem classes, tutorials or workshops, as appropriate for the course. You will generally be expected to hand in your work so that we can monitor your progress. The detailed arrangements for coursework will vary between courses and you will be told about them at the start of each course. *You should ensure that you know what is required for each course that you take*.

Our teaching assumes that you have attempted the coursework, and we may refer to it in subsequent classes and coursework. *In-course assessment is compulsory: it contributes to your final examination mark for that course and non-submission may mean that you cannot pass the course* (see "Examinations" section on page 29). Furthermore, for courses with tutorial classes your tutor will record whether you have submitted each piece of non-assessed coursework by the specified deadline and whether it is a reasonable attempt (i.e. an attempt of pass standard). The Department of Statistical Science expects a reasonable attempt for at least 70% of non-assessed coursework in each course. If you fail to satisfy this requirement you may be barred from taking the examination for the course.

Ensure that you leave yourself enough time to complete each exercise sheet. Weekly sets of exercises may well need about 5 hours work on them, including reading time. In some courses, more substantial sets of exercises are given out on a fortnightly basis: it is recommended that you start them in the *first* of the two weeks allowed. A prompt start to exercises set for in-course assessment is well advised.

It is good practice to aim for legibility, accuracy and clarity in your coursework, whether or not it is for in-course assessment (the same applies to examinations, of course!).

Self study

After a lecture, study your notes carefully. Work through the details slowly and annotate your notes in a different colour to that used in taking them; this can help with revision. It is important to keep on top of each course by reviewing the appropriate notes *before the next class* (lecture, tutorial, problem class or workshop). Read supporting material from textbooks as necessary. Start coursework well in advance of the submission date (see the above comments on coursework).

The following will help you understand and communicate your understanding of course material:

- continual practice at solving problems;
- thorough preparation for all classes;
- regular revision of course material as the course progresses;
- seeking help when you have difficulties.

The Department has prepared a self assessment questionnaire to help you to evaluate what you are getting out of your studies and to take responsibility for your own progress. This questionnaire is available on the DOSSSH Moodle page (under the Student Feedback topic). Try completing it for each course during reading week.

Total workload

For a typical 15 credit course, you should expect a workload of about *9 or 10 hours per week* – this includes lectures, workshop, problems class, tutorial, reading and coursework, as appropriate for each course. For example, if you are studying the equivalent of four 15 credit courses per term, your total weekly workload is expected to be around *40 hours.*

As part of monitoring your own progress, you may find it helpful, in some weeks, to keep a diary of the time you spend actively working.

DEGREE PROGRAMME SPECIFICATIONS

Course codes

Each course offered in a programme has a code: this consists of a four character prefix which indicates the examination board responsible for that course, followed by another four characters indicating a course code within that board. Courses in Statistical Science have the prefix STAT (see the lists of courses that follow). However, you will often find that staff refer to course codes as simply G1 for STATG001 (for example).

Selecting courses

Each degree programme has some compulsory courses that cover the core material. These are then supplemented through the choice of appropriate options to make up a total of 180 credits for the entire programme. To take an optional course, you must register for it on Portico. Instructions on how to do this can be found on the Portico website (log on to Portico and select the “Module registration documentation” option from within the “Module Selection” container). In choosing options, you are advised to try and balance the amount of work evenly between the two terms.

In response to feedback from students, Student and Registry Services are putting processes in place to release the timetable of centrally organised examinations earlier in 2017/18. As a result, it is necessary to bring the deadline for the confirmation of module choice forward. All modules you intend to take in 2017/18, including modules for term 2, must be confirmed on Portico by 6 December 2017.

You will not be able to change your term 2 module selection after 6 December. It is therefore essential that you make sure you research your module choices thoroughly before selecting them. If you want to make a change after you have confirmed your module choices, please consult the MSc Tutor. Changes can be made by the Programme Administrator and you will need to request any changes to your term 2 module registrations in good time before the deadline.

MSc Data Science

Aims and objectives

To provide a one year taught MSc qualification for professionals in need of developing computational and statistical skills for large-scale data analysis in industry, government and research. A student on completion of the MSc programme should have acquired:

- knowledge and understanding of: traditional branches of statistics; algorithms and computational methods for modern statistical inference and their scalability; statistical applications that require the integration of a variety of data sources and customized tools for analysis.
- an ability: to select appropriate statistical methodologies for a problem at hand, and to set adequate computational trade-offs according to the scale of the problem and goals of the analysis; to provide an assessment and communication of the outcomes of an analysis, indicating points of improvement and which reliable conclusions can be drawn, acknowledging uncertainty; to lead efforts to extract new insights from available data originally collected with different purposes and with varying levels of error, and to ensure its quality.
- Practical skills to: use appropriate statistical methods for data analysis; interpret the outcome of a statistical analysis; use appropriate algorithms and software as required by the problem; design customized tools for problems that cannot be easily tackled with available software; integrate data available under a variety of sources and sampling biases.
- an ability to: communicate ideas effectively both orally and in writing; work independently and in groups; communicate with data providers to clarify the scope of a data analysis project; manage a project in a timely and organized manner, setting realistic goals and assessment criteria; monitor progress by self-assessment and by asking for appropriate feedback; be flexible on which methods and tools can be used in practice for any project, and adapt them as necessary during its lifetime.

Curriculum

Compulsory

Course Code	Course Title	Term
COMPGI21	Introduction to Machine Learning	1
STATG000	Foundation Course	1[1]
STATG002	Statistical Design of Investigations	1
STATG003	Statistical Computing	1 & 2
STATG006	Introduction to Statistical Data Science[2]	1
STATG099[3]	Research Project	Jun - Sep[4]

[1] The Foundation Course begins one week before the start of term 1.
[2] Students may not take both STATG001 and STATG006.
[3] The same course code is used for the project modules of all three programmes listed at the top of page 1, but students are expected to select a research topic that is appropriate to their particular field of study.
[4] Training sessions for the project are held throughout the year.

Optional

Choose four courses, normally at least two from the following list:

Course Code	Course Title	Term
STATG004	Applied Bayesian Methods	2
STATG009	Decision & Risk	2
STATG010	Stochastic Systems[5]	1
STATG011	Forecasting	2
STATG017	Stochastic Methods in Finance I	1
STATG018	Factorial Experimentation	2
STATG019	Selected Topics in Statistics	2
STATG020	Stochastic Methods in Finance II	2
STATG022	Quantitative Modelling of Operational Risk & Insurance Analytics	2

and up to two from the following list:

Course Code	Course Title	Term
COMPGI08	Graphical Models	1
COMPGI15	Information Retrieval & Data Mining	2
COMPGI17	Affective Computing & Human-Robot Interaction	2
COMPGI19	Statistical Natural Language Processing	1

Subject to the constraint that at least two of the four courses must be taken from within Statistical Science, students may substitute some of these options for other courses offered by the Departments of Computer Science and Statistical Science and/ or may choose one course from other data science-related modules offered in the College. Such courses are sometimes referred to as *electives*. The timetable will not be amended so that you may accommodate an elective course. However, students may usually take electives that are scheduled for Friday afternoons even though these clash with occasional workshops for statistics courses: in this case, it is the student's responsibility to catch up on any work missed as a result of the clash.

Please remember that your registration for any non-compulsory course is subject to approval both by the MSc Tutor and by the Department offering the module. Attempts to register for unsuitable modules will be rejected. If you are in any doubt as to whether you will be allowed to take a particular course, you should discuss it with the MSc Tutor, ***BEFORE*** *attempting to register for it on Portico.*

Part time study

The MSc Data Science is available for part time study. The part time MSc is a two year programme. The rules are the same as for the full time programme, with the same compulsory and optional courses (special teaching times are not offered for part time students). Students are expected to split the eight taught courses evenly between the first and second years. It may be permitted to split the eight courses 3:5 or 5:3 over the two years instead, but this has to be approved by the MSc Tutor.

The Foundation Course is taken at the beginning of the first year. It is recommended that students take STATG006 in the first year, and prerequisites of courses need to be fulfilled, but otherwise there are no restrictions on which courses are taken in which year. Part time students submit their project at the end of their second year. It is possible to arrange with the project supervisor to start to work on the project earlier than full time students, but part time students are not entitled to a higher overall amount of supervision.

[5] To study STATG010 Stochastic Systems, students should have previously studied at least one undergraduate introductory course in applied probability covering discrete- and continuous-time Markov Chains.

MSc Statistics

Aims and objectives

To provide a one-year taught Masters degree in Statistics for more advanced training in statistical theory and applications, which enables graduates to enter specialist employment or academic research. A student on completion of the MSc programme should have acquired:

- a grounding in a selection of traditional branches of statistics;
- an introduction to modern ideas of statistics such as applied Bayesian methods, generalised linear modelling and object oriented statistical computing;
- an introduction to a selection of applications of statistics from medicine, industry and finance;
- experience of seeking out, interpreting and presenting statistical ideas or information, both orally and by written report.

Curriculum

Compulsory

Course Code	Course Title	Term
STATG000	Foundation Course	1[6]
STATG001	Statistical Models & Data Analysis[7]	1
STATG002	Statistical Design of Investigations	1
STATG003	Statistical Computing	1 & 2
STATG004	Applied Bayesian Methods	2
STATG099[8]	Research Project	Jun - Sep[9]

Optional

Choose four courses, normally from the following list:

Course Code	Course Title	Term
STATG009	Decision & Risk	2
STATG010	Stochastic Systems[10]	1
STATG011	Forecasting	2
STATG012	Statistical Inference[11]	1
STATG015	Medical Statistics I	1
STATG016	Medical Statistics II	2
STATG017	Stochastic Methods in Finance I	1
STATG018	Factorial Experimentation	2
STATG019	Selected Topics in Statistics	2
STATG020	Stochastic Methods in Finance II	2
STATG021	Bayesian Methods in Health Economics	2
STATG022	Quantitative Modelling of Operational Risk & Insurance Analytics	2

[6] The Foundation Course begins one week before the start of term 1.
[7] Students may not take both STATG001 and STATG006.
[8] The same course code is used for the project modules of all three programmes listed at the top of page 1, but students are expected to select a research topic that is appropriate to their particular field of study.
[9] Training sessions for the project are held throughout the year.
[10] To study STATG010 Stochastic Systems, students should have previously studied at least one undergraduate introductory course in applied probability covering discrete- and continuous-time Markov Chains.
[11] The course on Statistical Inference is compulsory for MSc students needing to reinforce this area.

In some circumstances, you may choose one course from other statistics-related modules offered in the College. Such selections are sometimes referred to as *electives*. The following are recent examples of elective courses that previous students have taken:

Course Code	Course Title	Term
COMPG001	Financial Data and Statistics	2
COMPGI01	Supervised Learning	1
MATHGF06	Applied Computational Finance	2
MSING034	International Capital Markets	2

The timetable will not be amended so that you may accommodate an elective course. However, students may usually take electives that are scheduled for Friday afternoons even though these clash with occasional workshops for statistics courses: in this case, it is the student's responsibility to catch up on any work missed as a result of the clash.

Please remember that your registration for any non-compulsory course is subject to approval both by the MSc Tutor and by the Department offering the module. Attempts to register for unsuitable modules will be rejected. If you are in any doubt as to whether you will be allowed to take a particular course, you should discuss it with the MSc Tutor, ***BEFORE*** *attempting to register for it on Portico.*

Part time study

The MSc Statistics is available for part time study. The part time MSc is a two year programme. The rules are the same as for the full time programme, with the same compulsory and optional courses (special teaching times are not offered for part time students). Students are expected to split the eight taught courses evenly between the first and second years. It may be permitted to split the eight courses 3:5 or 5:3 over the two years instead, but this has to be approved by the MSc Tutor.

The Foundation Course is taken at the beginning of the first year. It is recommended that students take STATG001 in the first year, and prerequisites of courses need to be fulfilled, but otherwise there are no restrictions on which courses are taken in which year. Part time students submit their project at the end of their second year. It is possible to arrange with the project supervisor to start to work on the project earlier than full time students, but part time students are not entitled to a higher overall amount of supervision.

MSc Statistics (Medical Statistics)

Medical Statistics is a pathway of the regular MSc Statistics, which means that the rules for the MSc Statistics also apply to the MSc Statistics (Medical Statistics), with some additional restrictions.

Aims and objectives

Medical Statistics is a fundamental scientific component of health research. Medical Statisticians interact closely with biomedical researchers, epidemiologists and public health professionals and contribute to the effective translation of scientific research into patient benefits and clinical decision-making. As new and more complex biomedical problems emerge, medical statistics faces exciting challenges in the novel application of existing tools and the development of superior methods.

A priority for the National Institute for Health Research is to build research capacity in medical statistics, as there is currently a shortage of individuals with sufficient training and expertise in this area to support the current volume of health research. The Medical Statistics pathway provides students with a sound background in theoretical statistics as well practical hands-on experience in designing, analysing and interpreting health studies. The aim is to equip students with the skills needed to work as medical statisticians in the

pharmaceutical industry, universities, the NHS, and clinical trials and other medical research units.

Curriculum

Compulsory

Course Code	Course Title	Term
STATG000	Foundation Course	1[12]
STATG001	Statistical Models & Data Analysis	1
STATG003	Statistical Computing	1 & 2
STATG004	Applied Bayesian Methods	2
STATG012	Statistical Inference	1
STATG015	Medical Statistics I	1
STATG016	Medical Statistics II	2
STATG099[13]	Research Project	Jun - Sep[14]

Optional

Choose one course from the following list:

Course Code	Course Title	Term
STATG002	Statistical Design of Investigations	1
EPIDGS31	Epidemiology	1

and one course from the following list:

Course Code	Course Title	Term
STATG021	Bayesian Methods in Health Economics	2
GENEG005	Statistics for interpreting Genetic Data	2

MSc Computational Statistics and Machine Learning

The specifications of this programme are available from the Department of Computer Science at: http://www.cs.ucl.ac.uk/prospective_students/msc_computational_statistics_and_machine_learning/.

MSc Data Science and Machine Learning

The specifications of this programme are available from the Department of Computer Science at: http://www.cs.ucl.ac.uk/prospective_students/msc_data_science_and_machine_learning/.

MSC PROJECT

Guidelines for preparation and submission

Students should plan to take a short break after their written examinations, before starting work on their projects. All supervisors are likely to be away from time to time during the period June-September, attending conferences or on holiday. Students should therefore see their supervisors as soon as their examinations are over, to make mutually convenient arrangements for starting work on their projects.

[12] The Foundation Course begins one week before the start of term 1.
[13] The same course code is used for the project modules of all three programmes listed at the top of page 1, but students are expected to select a research topic that is appropriate to their particular field of study.
[14] Training sessions for the project are held throughout the year.

Over the course of the project, student and supervisor should arrange to meet regularly (about once a week, whenever possible) and should agree a suitable timetable for completing the work and producing a written account. The supervisor should advise the student to start to write up the work, and to ask for the supervisor's feedback on their writing, early in this period.

Supervisors will provide feedback on an entire draft of the project dissertation on at least one occasion, providing it is available in at least three weeks before the deadline for submission. Any request for feedback after this deadline is at the discretion of the supervisor. Supervisors should provide feedback within two weeks.

Final (word-processed) dissertations should be handed in to the Departmental Office by 16:00 on the advertised date (this is normally at the start of September). Late submissions will incur severe “lateness” penalties (see “Late Submission Penalties” section on page 30). Furthermore, an electronic version of the dissertation should be submitted via Moodle on the same day (the MSc Tutor will circulate more detailed instructions nearer to the date).

The length of a project dissertation will depend on the topic of the project and may vary considerably. Lengths between 8,000 and 15,000 words (excluding computer programs, tables, graphs, formulae and other output) are generally acceptable. Typical projects are between 10,000 and 12,000 words long.

Each dissertation should include a table of contents, an introduction, a conclusion or discussion section, and a list of references. The reference list should include all references that have been used to support the work reported in the project; and these references should be cited in the text of the dissertation as appropriate to indicate where they have been used, following accepted conventions for citation. The pages should be clearly numbered and should have a left-hand margin of at least 2cm. Examiners attach *considerable* importance to accuracy, clarity and overall quality of presentation.

In addition to the project dissertation, each student will be required to give a presentation on their research. The time normally allocated to each presentation is 15 minutes excluding questions. Students are expected to attend and actively participate in the oral presentations by other students. Presentations normally take place in early September; students therefore need to ensure that they are available in the Department at this time.

Specific dates for the arrangements referred to in the third and fourth bullet points above will be provided separately. *Please ensure that you are aware of them.*

Guidelines for assessment

Project dissertations are read independently by two examiners, one of whom is normally the candidate’s project supervisor. Each examiner provides a brief written assessment. Dissertations are also read by a visiting examiner. The final mark is agreed by the whole exam board, which includes the visiting examiner. It is possible, but not usual, that a student may be required to take an oral examination before a final mark is assigned. The final mark should be interpreted in accordance with the guidance notes on page 14.

Examiners will satisfy themselves that the dissertation is the work of the candidate, and will take into account the following points:

- the difficulty and novelty of the project;
- the amount of new methodology/ application knowledge that the student was required to learn;

- the degree of direction required from the project supervisor;
- the student's progress throughout the project.

Subject to these overall criteria, examiners will consider both the content of the dissertation and its presentation, with a higher priority being attached to content. Aspects considered will usually include the following:

- *Content*: amount of work done; extent to which understanding has been demonstrated; quality and accuracy of reasoning, validity of interpretation, relevance of conclusions; critical appraisal, discussion of limitations and suggestions for further work; clarity of objectives; quality of literature review; quality of data organisation and collection (if applicable); quality of programming or use of software (if applicable).
- *Presentation*: layout of dissertation and care in its presentation; structure of the dissertation; use of appropriate judgement in selecting material; clarity of expression, readability and coherence; correctness of grammar and spelling; adequacy of diagrams, graphs and tables (if applicable); quality of presentation of mathematical material (if applicable).

A mark less than 50 will be awarded if the material, though correct, is judged to be wholly reproduced in a purely technical manner.

For a mark over 85, it is expected that the student, in addition to having submitted a well-presented dissertation demonstrating a good understanding of the material and a comparatively high amount of work, will also have shown some initiative rather than simply following instructions. Marks of 90 or more may be appropriate where in addition the technical or conceptual difficulty of the material is very high, or where some of the work could be considered original research on the part of the student.

The length of project dissertation will depend on the topic of the project and may vary considerably. Lengths between 8,000 and 15,000 words (excluding computer programs, tables, graphs, formulae and other output) are generally acceptable. Typical projects are between 10,000 and 12,000 words long. Over-length dissertations will be penalised (see page 30). It is generally required that the amount of work done and demonstrated is high enough, and that the material is presented in a way understandable to fellow students with a comparable background (so 8,000 words may only be an appropriate length for a very theoretical or densely presented dissertation). On the other hand, dissertations should not be too repetitive or contain unnecessary or irrelevant details, which may lead to downmarking. Although the word counts given above exclude appendices, tables and program listings, these items will also be penalised if they are excessive.

Each project presentation will be assessed by two examiners. Normally, neither of the examiners will be the candidate's supervisor. The examiners make independent notes on the presentation prior to discussing and agreeing a mark. Aspects considered will usually include the following:

- *Content*: was the presentation interesting? Did it focus on the important aspects of the work and flow logically? Was there sufficient detail to be intelligible to statistically literate listeners who do not have an in-depth knowledge of the specific topic? Were there clear aims and conclusions?
- *Presentation skills*: was the verbal presentation confident and clearly audible with varied inflexion? Did the presentation engage with the audience? Were visual aids clear, well produced and well used? Were questions handled appropriately? Was the amount of material appropriate for the time allowed?

EXTENUATING CIRCUMSTANCES AND REASONABLE ADJUSTMENTS

Reasonable adjustments

UCL will make Reasonable Adjustments to learning, teaching and assessment to ensure that students with a disability are not put at a disadvantage. UCL also provides Reasonable Adjustments for students who might not consider themselves to have a 'disability' but who nevertheless would benefit from additional support due to an ongoing medical or mental health condition. It is the responsibility of the student to request Reasonable Adjustments, and students are encouraged to make a request as early as possible.

Further information:

- Reasonable Adjustments
- Student Disability Services

Special examination arrangements

Special Examination Arrangements (SEAs) are adjustments to central or departmental written examinations which can be made as a Reasonable Adjustment for students with a disability or longer-term condition or as a form of mitigation for students with shorter-term medical Extenuating Circumstances. This may include, but is not limited to extra time, a separate room, rest breaks and specialist equipment. Students must make an application to use the special examination facilities.

Further information:

- Special Examination Arrangements – guidance and forms
- Special Examination Arrangements – regulations

Any special arrangements that are agreed for you will automatically be taken into account in all centrally-organised exams held during the main exam period in term 3. However, in order to have your requirements taken into account for any departmentally-organised assessments held outside the main exam period, you must provide the relevant department with a copy of your letter *in advance of the test date*.

Extenuating circumstances

Extenuating circumstances are defined by UCL as circumstances in a student's life that are unexpected, significantly disruptive and beyond the student's control and which may affect their performance at assessment. Wherever possible, UCL is responsible for ensuring that students are not unfairly disadvantaged by such circumstances by putting in place alternative arrangements, such as an extension or a deferral of assessment to a later date.

The extenuating circumstances regulations provide short-term solutions for students experiencing sudden, unexpected difficulties. They are not designed to support students with longer-term or chronic conditions or disabilities. UCL seeks to ensure that such students are enabled to achieve their full potential at assessment by putting in place appropriate special examination arrangements (see the previous section).[15]

[15] It is, however, recognised that a student with a chronic or long-term condition may nonetheless experience an acute episode or sudden worsening of their condition, or that the condition might be newly-diagnosed. Such students are encouraged to seek support through Student Disability Services, but may also need to submit an extenuating circumstances claim if, for example, there is insufficient time to put special examination arrangements in place.

Examples of extenuating circumstances that would commonly be regarded as having seriously affected a student's performance are:

- death of, or serious injury to, a close relative;
- a serious personal injury or medical condition;
- being the victim of a serious crime (e.g. assault, mugging);
- theft of work required for assessment.

Examples of circumstances that would not normally be considered are:

- minor illnesses or injuries (e.g. colds, headaches, hay fever);
- assessment / examination stress (e.g. because of tight exam timetabling);
- failure of IT equipment / printers;
- minor private or public transport failure.

However, these lists are by no means exhaustive and additional guidance on the types of claims that might be considered is available from the UCL Academic Manual: https://www.ucl.ac.uk/silva/srs/academic-manual/documents/annexes_2017_18/chapter_4_annexes_17_18/Annex-4.1.1-Grounds-for-Extenuating-Circumstances.pdf. Furthermore, UCL recognises that each student's circumstances are different and that claims must be considered on a case-by-case basis.

You are responsible for making known any circumstances which may affect your performance in good time for them to be considered by the appropriate UCL body. You must complete an Extenuating Circumstances Claim Form (available from the DOSSSH Moodle page) and submit this, together with appropriate supporting evidence, to the Teaching Administrator as soon as possible and ***NO*** *later than one week after the circumstance has taken place*. Claims must clearly state the modules / components for which you are seeking mitigation; claims will not be considered for any modules not identified on the claim form.

Claims must be supported by written evidence from an appropriate, verifiable and independent authority such as a registered medical practitioner, solicitor, undertaker, registrar of births, marriages and deaths, police officer, fire officer, court or tribunal officer. Evidence must cover the full period for which you are claiming mitigation and must be provided in English or accompanied by a translation formally notarised by a solicitor. If you are unable to obtain evidence in order to submit your claim within the one week deadline, you should submit the claim on time, indicating on the form that the evidence is to follow.

Depending on the type of mitigation being requested, your claim will be reviewed by relevant members of staff from the Department and / or MAPS Faculty, who will make a decision either to accept or reject the claim, or to request additional evidence. You will be notified in writing within one week of the decision being made. Where a claim is accepted, the notification will include details of the mitigation to be applied. Where further evidence is required, you will be expected to provide this within a further two weeks.

Unless you follow the above procedure, it will ***NOT*** *be possible for the examiners to take any extenuating circumstances into account*. Details of the precise circumstances affecting individual students are not made available to all examiners.

Further information:

- Extenuating Circumstances Regulations

Support to study policy and fitness to study procedure

Students with physical or mental health concerns are encouraged to make contact with the available support services as early as possible so that UCL can put in place reasonable adjustments to support them throughout their studies. However there may be occasions when a student's physical or mental health, wellbeing or behaviour is having a detrimental effect on their ability to meet the requirements of their programme, or is impacting on the wellbeing, rights, safety and security of other students and staff. In such cases UCL may need to take action under the Fitness to Study Procedure.

Further Information:

- Support to Study Policy
- Fitness to Study Procedure
- Student Psychological Services
- Student Support and Wellbeing
- Learning Agreements, Barring, Suspensions and Terminations of Study
- Student Disciplinary Code and Procedures
- UCL Student Mental Health Policy

EXAMINATIONS

Complete and non-complete courses

In order to qualify for the award of a Masters degree, students must have completed 180 UCL credits. Unless there are strong mitigating circumstances (e.g. medical), you will be non-complete for a particular course if:

- you are absent from the final examination, or make little or no attempt;
- you fail to submit a piece of coursework worth more than 20% of the overall mark.

You may also be declared non-complete in a course if your attendance is insufficient or you don't hand in enough non-assessed coursework (see page 18). To avoid being non-complete for a particular course through absence from an assessment, students must obtain authorisation for the absence by submitting a request for extenuating circumstances (see "Extenuating Circumstances" section on page 27).

Components of compulsory assessment

Details of each component of compulsory assessment and the proportion it normally contributes towards the final mark are given for each course in the "Course Information" section from page 47 onwards.

In-course assessment

At the beginning of each course, the lecturer will provide details of the method and dates of in-course assessment and the amount of work involved. The assessment dates will also be posted on the course Moodle page. Students should ensure that they have no other commitments on these dates; *in-course assessment is a form of examination, and should be treated as such.* For students required to resit the in-course assessment during the late summer, an alternative form of assessment may be employed for the second attempt.

Each piece of in-course assessment set by the Department of Statistical Science has its own rubric and the instructions given must be followed. *In particular, do pay attention to the consequences of missing the deadline set, non-submission and plagiarism; any of these can result in your not passing the course.* Teaching staff will set aside extra office hours to

discuss assessment-related matters (see page 12) students should respect the lecturers' time by confining queries to these hours.

Some assessments will be in the form of a "take-home" assignment, to be handed in to the Departmental Office or the course lecturer by a set deadline. For such assessments, you will need to sign a cover sheet (provided by the course lecturer) containing a declaration that the submitted work is entirely your own (see "Plagiarism and collusion" section on page 31). You will also need to submit your work in a *single securely stapled bundle* including the cover sheet.

Late Submission Penalties: Planning, time-management and the meeting of deadlines are part of the personal and professional skills expected of all graduates. For this reason, UCL expects students to submit all coursework by the published deadline date and time, after which penalties will be applied. If a student experiences something which prevents them from meeting a deadline that is sudden, unexpected, significantly disruptive and beyond their control, they should submit an Extenuating Circumstances Form (see "Extenuating Circumstances" section on page 27). If the request is accepted, the student may be granted an extension. If the deadline has already passed, the late submission may be condoned i.e. there will be no penalty for submitting late.

Further information:

- Late Submission Penalties

Word counts: some assessments (usually involving the production of reports) carry a specified word count. The rubric will include clear instructions about word counts, the inclusion of footnotes, diagrams, images, tables, figures and bibliographies etc. Students are expected to adhere to the requirements for each assessment. Students exceeding these parameters may receive a reduction in marks.

Further information:

- Word Counts

The rubric may indicate that the word count excludes appendices. *However, this should not be regarded as an invitation to transfer large amounts of surplus text into an appendix and the mark awarded will reflect the standard of judgement shown in the selection of material for inclusion.*

Written examinations

These normally take place during term 3. Student and Registry Services will contact you with details of your personal examination timetable, normally just before the end of term 2.

Students must ensure that they are aware of the regulations governing written examinations detailed in the *UCL Examination Guide for Candidates* on the Examinations and Awards website. Students should pay particular attention to the regulations around examination irregularities. Students who are suspected of any form of cheating or of breaching the Examination Regulations will be investigated under UCL's Examination Irregularities and Plagiarism procedures (see "Examination Irregularities" section on page 33).

Further information:

- Examination Regulations

In most examinations set by the Department of Statistical Science, there are two sections and candidates are required to answer all questions. The questions in section A are intended to be straightforward and to focus on core material, whereas those in section B are more challenging. The rubric will indicate the proportion of the total mark allocated to each section. Statistical tables will be provided by the College in all examinations set by the Department (the currently provided tables are *New Cambridge Elementary Statistical*

Tables by D.V.Lindley & W.F.Scott). You should take a pocket calculator to all of these examinations (see page 14 for details of permitted calculators).

Recent past examination papers are available for consultation on the UCL Library Services website: http://digitool-b.lib.ucl.ac.uk:8881/R&?local_base=EXAMPAPERS.

Final course mark

To pass a course at Masters level, a final mark of at least 50 is required. For courses with more than one assessment component, a guideline is given later in this handbook to indicate the scheme used for combining the individual marks. This guideline will normally be adhered to, but is subject to change at the discretion of the Board of Examiners.

Feedback on assessments

Regular feedback is an essential part of every student's learning. It is UCL policy that all students receive feedback on summative assessments within one calendar month of the submission deadline. This feedback may take the form of written feedback, individual discussions, group discussions, marker's answers, model answers or other solutions (although students should note that UCL is generally unable to return examination scripts or comments on the same). Students writing dissertations or research projects should also expect to receive feedback on a draft on at least one occasion.

If, for whatever reason, a department/division cannot ensure that the one calendar month deadline is met then they will tell students when the feedback will be provided - it is expected that the extra time needed should not exceed one week. Where feedback is not provided within the timescale, students should bring the matter to the attention of their Programme Tutor or Head of Department.

Further information:

- UCL Feedback Turnaround Policy

Plagiarism and collusion

Plagiarism means attempting to pass off someone else's work as your own, while collusion means passing off joint work as your own unaided effort. Both are unacceptable, particularly in material submitted for examination purposes including exercises done in your own time for in-course assessment. Plagiarism and collusion are regarded by the College as examination irregularities (i.e. cheating) and are taken extremely seriously. UCL uses a sophisticated detection system (Turnitin®) to scan work for evidence of plagiarism and collusion, and the Department reserves the right to use this for assessed coursework. This system gives access to billions of sources worldwide, including websites and journals, as well as other work submitted to the Department, UCL and other universities. It is therefore able to detect similarities between scripts that indicate unacceptable levels of collusion, as well as material taken from other sources without attribution.

If plagiarism or collusion are suspected, on the basis either of the Turnitin® software or other evidence, it can be dealt with informally only in the case of first offences. All other cases must be dealt with formally, which involves adjudication by a departmental panel and/or College Examinations Irregularities panel (see "Examination Irregularities" section on page 33).

What isn't acceptable?

Students sometimes find it difficult to know what counts as plagiarism or collusion. The following list is not exhaustive, but gives some indication of what to avoid. It is based on guidelines developed by Nick Hayes of the UCL Pharmacology Department. You may **NOT**:

- Create a piece of work by cutting and pasting material from other sources (including websites, books, lecture notes and other students' work).
- Use someone else's work as your own. This includes, but is not limited to:
  - Making notes while discussing an assessment with a friend, and subsequently using these as the basis for all or part of your submission.
  - Telephoning another student to discuss how best to carry out a particular piece of analysis.
  - Employing a professional ghostwriting firm or anyone else to produce work for you.
- Use somebody else's ideas in your work without citing them.
- Ask a lecturer in the department for help with assessed work, unless you make it clear to them that the work is assessed.
- Help another student with their assessed work. If you do this, you will be deemed to be guilty of an examination irregularity.

What is acceptable?

The following practices do not constitute plagiarism / collusion:

- Quoting from other people's work, with the source (e.g. book, lecture notes, website) clearly identified and the quotation enclosed in quotation marks.
- Summarising or paraphrasing other people's work, providing they are acknowledged as the source of the ideas (again, usually this will be via a reference to the book, journal or website from which the information was obtained).
- Asking the course lecturer for help with difficult material, providing it is clear that the question is in connection with the assessment. The lecturer will be able to judge for him or herself what is an appropriate level of assistance.

Some examples

Unfortunately, each year there are some students in the Department of Statistical Science who submit work that contravenes the regulations. The consequences can be severe.

Example 1: Final-year student A had a lot of coursework deadlines in the same week as an important job interview. One of the coursework deadlines was for an extended piece of data analysis, set two weeks previously. Because of his other commitments, student A did not start this piece of coursework until shortly before the deadline, at which point he discovered that he did not have enough time to do it. He asked student B for help. The result was that both students submitted essentially identical work using exactly the same computer output. A departmental panel was convened to investigate the matter. The panel suggested that student B had passed electronic material (computer output and graphics files) to student A, who had pasted this material straight into his own submission. Although student A admitted asking student B for help, both students denied exchanging electronic material. They were, however, unable to explain how the same electronic files came to appear in both submissions. As a result, the allegation was upheld and both students were penalised. Student A was recorded as "non-complete" for the course in question (this meant that he

had no possibility of passing it that year), and student B was given a mark of zero for the coursework component.

Example 2: Students C and D both had to submit some computer code for an assessment, which was worth one third of the total mark for a course. There was considerable flexibility in how to go about the assessment. Although the students submitted code that looked very different, closer inspection revealed that they were carrying out the same procedures in more or less the same order, and that the methods they used to carry out these procedures were essentially the same. Further, these procedures and methods were not used by other students in the class. On investigation, it transpired that the students had discussed the assessment over the phone while sitting in front of their computers. This is unacceptable, and as a result the marks of both students for this piece of assessment were halved.

Example 3: The in-course assessment for a particular module was organised as a multiple choice exam taken via Moodle outside of lessons. Each student could attempt the one-hour exam at any time of their choosing within a ten day window, but were clearly advised that they must work alone. After the exams had been graded, it was noticed that students E and F had given identical answers to every question (including incorrect answers). Inspection of the Moodle logs revealed that the students had started and finished their attempts at exactly the same time, using IP addresses that were traced to adjacent PCs in the same computer cluster. Students E and F admitted colluding on the in-course assessment and were both given a mark of zero.

How to avoid plagiarism and collusion

If you are found to have committed an offence of plagiarism or collusion, it makes no difference whether or not you intended to do so. Ignorance is no excuse. To avoid committing an offence, a useful rule of thumb is: if in doubt, don't do it. Make sure that any work you submit is your own unaided effort. More specific guidance is as follows:

- Plan your work schedule carefully, to allow enough time to complete each piece of assessment.
- If you have genuine problems in meeting a deadline, don't take the easy way out and borrow a friend's work. Discuss your difficulty with the course lecturer in the first instance.
- If you are stuck with an assessment, don't ask another student for help. Discuss it with the course lecturer.
- If another student asks you for help with an assessment, or asks to see your work, suggest that they approach the course lecturer instead. Remember: if somebody else copies or uses your work, you will be penalised as well, even if you didn't expect them to use your work in this way.

More information can be found at http://www.ucl.ac.uk/current-students/guidelines/plagiarism, and in the UCL Library Services WISE courses (see page 12).

Examination irregularities

UCL students are expected to be aware of and adhere to UCL's referencing and examination requirements as a condition of their enrolment:

- **For examinations**, the *UCL Examination Guide for Candidates* is published annually on the Examinations and Awards website. All candidates for written examinations must ensure they are familiar with the requirements for conduct in examinations set out in this guide.

- **For coursework submissions**, students must ensure that they are familiar with the UCL Library Guide to References, Citations and Avoiding Plagiarism which provides detailed guidance about UCL's referencing and citation requirements. Students should also ensure that they are familiar with the specific referencing requirements of their discipline.

Any student suspected of examination misconduct, plagiarism, self-plagiarism, collusion, falsification or any other form of academic misconduct which is likely to give an unfair advantage to the candidate and/or affect the security of assessment and/ or compromise the academic integrity of UCL will be investigated under the Examination Irregularities and Plagiarism procedures. If misconduct is found, students are likely to be failed for that assignment and/ or module. Serious or repeated offences may lead to failure of the whole year, suspension or even expulsion. A breach of copyright or intellectual property laws may also lead to legal action.

Further information:

- UCL Examination Guide for Candidates
- Library Guide to References, Citations and Avoiding Plagiarism
- Examination Irregularities and Plagiarism procedures
- Students can also seek advice from the Students' Union Advice Service

Examination marks

Marking, second-marking and moderation

All work that is submitted for summative assessment is marked by a UCL Internal Examiner or Assistant Internal Examiner. All UCL programmes also include rigorous second-marking and internal moderation processes to ensure that marking is consistent and fair. Second-marking can take a number of different forms depending on the type of assessment, but the overall aim is to ensure that marking is as accurate as possible. Internal moderation also helps UCL to ensure that marking is equitable across different modules, pathways, options and electives.

External examining at UCL

External Examiners are senior academics or practitioners from other universities who help UCL to monitor the quality of the education we provide to our students. In particular, External Examiners scrutinise the assessment processes on each programme, helping UCL to ensure that all students have been treated fairly, that academic standards have been upheld and that the qualifications awarded are comparable with similar degrees at other UK universities.

Each External Examiner submits an annual report. Faculties and departments are required to reflect on any recommendations and address any issues raised in a formal response. The report and response are discussed with Student Reps at the Staff-Student Consultative Committee, and are scrutinised by faculty, department and institution-level committees. Students can access their External Examiner's report and departmental response via their Portico account or by contacting their Departmental Administrator in the first instance or Student and Registry Services directly at examiners@ucl.ac.uk.

Boards of examiners

Module marks are finalised at meetings of examiners in the departments offering the courses. When finalising the marks, examiners in the Department of Statistical Science refer to the grade descriptors summarized in the "Feedback on student work" section on page 14.

Provisional results for the taught component and *provisional* award recommendations for postgraduate students registered in the Department of Statistical Science are released after the appropriate examiners' meetings, normally in June and November respectively. These results are provisional until confirmed by the College Examination Board later in the year and will be published online via the DOSSSH Moodle page. To access the provisional results online you will need your candidate ID number, along with your UCL userid and password. Students will be advised of the release date in advance via UCL email.

Appeals concerning examination results

Where informal resolution is not possible, candidates may appeal against their examination results under one or more of the following conditions:

- Either the examination and/ or classification process was not conducted in accordance with the relevant regulations/ procedures.
- The examiners could not reasonably be made formally aware of special circumstances (e.g. illness) notified by the candidate which significantly affected his/ her performance in the examination. For a candidate to appeal on these grounds, it is necessary to demonstrate that they could not reasonably have submitted the appropriate claim for extenuating circumstances by the required deadline (see page 27).
- There has been an arithmetical or transcription error in the compilation of the marks and/ or the result.
- There is substantive evidence that one or more of the examiners can be shown to have been biased or prejudiced against the candidate in one or more specific examinations.

Any such appeal should be pursued via the Student Complaints Procedure (see page 43). *Note that appeals will **NOT** be considered except under one or more of the conditions above.* The Department of Statistical Science would therefore like to reassure all students that all staff in the Department take the assessment process extremely seriously. The marking process described above is designed to ensure that papers are marked fairly and accurately, with all marks agreed by at least three examiners (two internal and one external) and any difficulties discussed by the entire Board of Examiners.

Prizes

Departmental

The following sessional prizes may be awarded to students on the MSc Data Science, MSc Statistics and MSc Statistics (Medical Statistics) programmes:

- *PSI Prize*: for outstanding overall performance.[16]
- *Project Prize*: for the best MSc project.[17]

Faculty

The Department may nominate outstanding students for consideration by the MAPS Faculty for the following award:

- *MAPS Postgraduate Prize*

[16] Awarded by PSI ("Statisticians in the Pharmaceutical Industry") on the recommendation of the Board of Examiners in Statistics, subject to annual renewal.
[17] If the same recipient would otherwise be selected for both prizes, there will instead be two prizes for outstanding overall performance (and no Project Prize).

Reassessment

The Programme Scheme of Award describes the modules which students must complete and pass in order to achieve their degree. Where a student fails to meet these requirements at the first attempt, and there are no Extenuating Circumstances material to that failure, they may be reassessed on one more occasion only, unless they have been awarded a degree, are eligible for the award of a degree, or have been excluded from UCL on the grounds of academic insufficiency or as a result of misconduct. Students who have passed a module are not permitted to resit or repeat that module.

Students who fail in up to 60 taught credits will be required to Resit in the Late Summer Assessment Period. Students failing more than 60 credits will be expected to Repeat the module(s) with tuition in the following academic year, but may, at the Board of Examiners' discretion, be permitted to Resit in the Late Summer Assessment Period.

There are separate provisions for students who fail due to Extenuating Circumstances - the Extenuating Circumstances Panel will determine the nature and timing of the Deferral, which may be offered with or without tuition/ attendance.

Students who fail a Masters dissertation/ research project will normally resit by 31 January. Exceptionally, the Board of Examiners may decide that the extent of failure is such that the student needs to Repeat the dissertation with tuition and fees.

Taught Postgraduate students who meet the Condonement Criteria will meet the Progression and Award Requirements and will not be permitted a further attempt.

Capping of reassessment marks

The marks for modules passed at the second attempt will be capped at the Pass Mark: 50. Students who defer their first attempt due to Extenuating Circumstances will not have their marks capped. Students deferring their second attempt (i.e. who have Extenuating Circumstances on a Resit or Repeat) will have their marks capped.

Further information:

- Consequences of Failure

SCHEME FOR THE AWARD OF AN MSC

The award of an MSc is based on marks for two elements: eight taught courses consisting of core and approved optional modules taken by the candidate (as detailed in the "Degree Programme Specifications" section beginning on page 19) and a research project.

For the award of an MSc, a student must pass all modules including the project. The pass mark is 50. The final mark for the programme will be computed as a 2:1 weighted average of marks for the taught component and project, respectively, with the taught component mark calculated as a straight average of marks from the eight taught courses.

The award of an MSc with Merit will be made if the overall mark is at least 60, the mark for the project is at least 60, but the criteria for the award of a Distinction have not been met.

The award of an MSc with Distinction will be made if the overall mark is at least 70 and the mark for the project is at least 70.

For students failing up to two taught courses with marks in the range 40-49, an MSc may be awarded at the discretion of the examiners, taking into account performance in other courses. Taking the lead from the QAA subject benchmark statement, which covers Masters-level programmes and which acknowledges that students may fail modules but still be worthy of reward (see Sections 4.16 and 4.17), the Board of Examiners in Statistics will normally recommend the award of an MSc in such circumstances unless there are very strong reasons not to do so. However, any candidate registered on the MSc Statistics (Medical Statistics) programme who is eligible to benefit from this concession, but who has achieved marks in the range 40-49 for both STATG015 and STATG016, will instead be awarded an MSc Statistics, i.e. the Medical specialisation will not be recognised in the award title.

CHANGES TO REGISTRATION STATUS

Students wishing to make changes to their registration status should first discuss their plans with their Personal Tutor or Programme Tutor who can explain the options available and help students to make the right decision. Students should also ensure that they read the relevant sections of the UCL Academic Manual before making any requests to change their academic record.

Further information:

- Changes to Registration Status

Changing programme

If a student wishes to transfer from one UCL degree programme to another, they must make a formal application. The normal deadline for change of degree programme during the academic session is 31 October each year. Students should log in to their Portico account and complete the online application under the 'C2RS Home' menu. Students are strongly advised to discuss their plan with the departments involved before requesting a change of programme on Portico.

Further information:

- Programme Transfers

Tier 4 students and changing programmes

Only some Tier 4 students are permitted to change their programme at UCL without first completing their previous programme. There are some circumstances where a Tier 4 student is permitted to change programme, however please be aware that this could affect your current Tier 4 visa and you could be required to apply for a new visa from outside the UK. Changing to a programme at a lower level than your previous/ current programme is not permitted under Tier 4 regulations.

If you are thinking of changing programmes at UCL and you hold a Tier 4 visa, please get in touch with the Visa Compliance Team for further information: visacompliance@ucl.ac.uk.

Interruption of studies

If a student requires a temporary break from their studies and plans to resume their programme at a future date, they must apply for a formal Interruption of Study.

Further information:

- Interruption of Study

Withdrawing from a programme

If a student wishes to leave their degree programme prior to completing their final examinations they must apply for a formal withdrawal from their studies. Once withdrawn, the student cannot return to the programme at a later date. Applications must be made in advance of the effective date of change. Students should log in to their Portico account and complete the online application under the 'C2RS Home' menu.

STUDENT SUPPORT AND WELLBEING

Central wellbeing and support services

UCL is committed to the wellbeing and safety of its students and tries to give assistance wherever possible to ensure that studying at UCL is a fulfilling, healthy and enjoyable experience. There is a wide range of support services for students - the Current Students Support website provides more information. Students should be aware that, while there are many services on offer, it is their responsibility to seek out support and they need to be proactive in engaging with the available services.

The Student Centre

The Student Centre provides front-line administrative services to UCL students and is an excellent source of information about the services provided by Student Support and Wellbeing. They can also provide advice about a range of Student Records enquiries and fulfil requests for proof of student status.

Further information:

- Student Centre website

Student Disability Services

Student Disability Services provide a comprehensive range of support services for students who have a disability which impacts upon their studies at UCL. They support students with physical and sensory impairments, specific learning difficulties, autistic spectrum disorders, mental health difficulties, and long-term health conditions. As well as arranging for adjustments to learning environments, the team loan out specialist equipment and provide one-to-one tutoring and support for students with specific learning difficulties.

Further information:

- Student Disability Services

Student Psychological Services

Student Psychological Services is dedicated to helping UCL students with personal, emotional and psychological concerns. The Student Psychological Services Team is diverse and consists of a variety of highly trained and experienced professionals, who offer short-term CBT and psychodynamic support. There are currently two psychiatrists and ten therapists on staff with varying kinds of psychological training and expertise.

Further information:

- Student Psychological Services

International student support and welfare

The International Student Support and Welfare Team provide specialist support and advice for all non-UK students at UCL. As well as immigration information, they help to support

students through the transition to university in the UK by organising the International Student Orientation Programme (ISOP) at the start of each term, and arranging regular workshops for international students which tackle particular issues.

Further information:

- International Student Support and Welfare

Accommodation

UCL Residences provides a range of accommodation options including three Halls of Residence, self-catered student houses and intercollegiate halls shared with other colleges of the University of London. Each Hall has a Warden and Vice-Warden to support students and foster a positive environment within the accommodation.

Further information:

- Wardens and Vice Wardens at UCL Residences

Financial support

At UCL we understand students can face a range of financial issues. We aim to help and advise students as much as possible, so that they have more control over their own financial situation. The Student Funding Team offer online information and one-to-one support through appointments as well as a drop-in service. Students with a more complex or sensitive circumstances can make an appointment with the Student Funding Welfare Adviser.

Further information:

- UCL Financial Support

Student of Concern

There are many sources of support for students who are having difficulties, but sometimes it is hard to know how to help a student who appears to be struggling, particularly if they seem unwilling or unable to seek the help they need. Anyone concerned about the behaviour of a student, who believes the problem may be related to health and wellbeing issues, is encouraged to complete the online UCL Student of Concern Form. Depending on the concerns raised, Student and Registry Service may respond by offering support or advice to the student or the person who submitted the form, liaise with support services or, if necessary, work with the relevant authorities to ensure the student is safe.

Further information:

- Student of Concern

Registering with a doctor and out-of-hours support services

Registering with a doctor

Students are strongly encouraged to register with a doctor as soon as possible after they arrive in London so that they can access healthcare as quickly as possible if they become ill or injured. When attending a university in the UK students are also advised to be vaccinated against Meningitis C.

The Ridgmount Practice is a National Health Service (NHS) practice providing healthcare and dental services for students living within its catchment area (i.e. near the main UCL campus). Students can also choose to register with a practice closer to where they live if they prefer. The Ridgmount Practice also runs a Walk-in Surgery which any UCL student can attend, even if they are not registered with the practice.

Further information:

- Register with a Doctor
- Ridgmount Practice website

Out-of-hours support and information helpline

UCL works in partnership with Care First to provide an out-of-hours support and information helpline. The helpline is free of charge and includes access to information specialists who are trained by Citizens Advice and to professionally-qualified and BACP-accredited counsellors who can help students with a range of emotional and psychological difficulties.

Further information:

- Care First

Crisis support - immediate help

If a student is in crisis there are a range of UCL and external sources of help such as Nightline, Ridgmount Medical Practice, Hall Wardens, Student Psychological Services and the Samaritans.

Further information:

- Crisis Support

Equality and diversity

UCL fosters a positive cultural climate where all staff and students can flourish, where no-one will feel compelled to conceal or play down elements of their identity for fear of stigma. UCL is a place where people can be authentic and their unique perspective, experiences and skills seen as a valuable asset to the institution. The Equalities and Diversity website brings together a range of information on issues relating to race, gender, religion and belief, sexual orientation, and disability amongst other equalities initiatives at UCL.

Departmental Equal Opportunity Liaison Officers

Departmental Equal Opportunity Liaison Officers (DEOLOs) provide support and assistance for students and staff about issues relating to equalities and diversity. The DEOLO for the Department of Statistical Science is **Ms KA Leport** (room 120, k.leport@ucl.ac.uk).

Further information:

- Equalities and Diversity
- Support for Pregnant Students
- Support for Students who are Parents
- Religion and Belief Equality Policy for Students
- UCL LGBT Student Support Pages
- UCL Chaplain and Inter-Faith Adviser
- DEOLOs (Departmental Equal Opportunity Liaison Officers)

UCL's zero tolerance policy on harassment and bullying

Harassment and bullying

Every student and member of staff has a right to work and study in a harmonious environment. UCL will not tolerate harassment or bullying of one member of its community by another or others and promotes an environment in which harassment and bullying are known to be unacceptable and where individuals have the confidence to raise concerns in the knowledge that they will be dealt with appropriately and fairly.

Further information:

- UCL Policy on Harassment and Bullying
- Students' Union Advice Service

Sexual harassment

It is unacceptable for any person at UCL, whether staff or student, to be subjected to any unwanted and persistent behaviour of a sexual nature. UCL is working with UCLU to implement a two-year action plan to tackle issues of sexual harassment and make sure that staff and students have access to relevant training. Any UCL student experiencing sexual harassment may access confidential support from a range of sources including their personal tutor or any other member of staff in their department or faculty who they trust, their Hall Warden, a UCLU student officer, the trained staff at the Students' Union Advice Service, or the UCL Student Mediator.

Further information:

- Zero Tolerance to Sexual Harassment

Support for students who have been affected by sexual violence

UCL will do its utmost to support anyone who has been, or is being, affected by sexual violence. If a student would like to talk to somebody at UCL, the Student Support and Wellbeing Team can offer advice on the support available both internally and externally.

Further information:

- Support for Students Who Have Been Affected by Sexual Violence

STUDENT REPRESENTATION

Students' Union UCL

The Union helps you to do more at UCL, experience something you've always dreamt of, turn a curiosity into a new passion and help you reach your potential. The Union cares about the things you care about, it's made up of all kinds of people from all kinds of places and it's there to fight for you when you need someone in your corner.

Students' Union UCL is the representative body of all UCL students. It's run by students for students and is a registered charity, independent of UCL. All UCL students at every level are automatically members of the Union (but can opt out), and the Union's leaders are elected annually by and from all current students. The elected leaders are called Sabbatical Officers and they represent students on various UCL committees and campaign on the issues that matter to students. Alongside the Sabbatical Officers are more than 1000 voluntary representatives, elected or appointed to cover every part of UCL life.

Further information:

- Students' Union website
- Membership information (including how to opt out)
- Elections information (including how to run for office)

Student societies

UCL students currently run over 250 different clubs and societies through the Students' Union, providing a wide range of extra-curricular activities for students to get involved with during their time at UCL.

Further information:

- Students' Union Clubs & Societies

Academic Representatives

Your Students' Union is there to make sure students have the best possible time while they're studying at UCL. One of the ways we do that is by working with departments and faculties to ensure that every student is represented and has a voice in the way that the university works.

Every student at UCL will have a Course Representative or a Research Student Representative who will be your eyes, ears, and voice. They'll work closely with staff in your department to make sure that they understand what you most value, and take action to deal with things you'd like to see improve. They'll also work with representatives in your faculty and the Students' Union to make things better across the whole of UCL.

If you take up a representative role, the Students' Union will work closely with you to provide training, support, and advice, and you'll be able to change the experience of everyone on your course or in your department for the better. Course and Research Student Representatives are appointing during early October – if you'd like to take up the role, staff in your department can tell you how.

Further information:

- Academic Representation website
- Find your Representative
- Become an Academic Representative

Staff-Student Consultative Committee

Every department at UCL has a Staff-Student Consultative Committee (SSCC) that meets at least three times a year. The SSCC is a forum for discussion between staff and student academic representatives. It's a great chance to work closely with staff to improve students' learning experience, and a big part of how together we make education better at UCL.

It is possible in principle for every interested student to attend the committee meetings (subject to space restrictions). The minutes of previous meetings are available on the DOSSSH Moodle page for students to consult.

Departmental Teaching Committee

This committee oversees the organisation and structure of the degree programmes and courses offered by the Department. It also considers teaching matters arising from meetings of the Staff-Student Consultative Committee. Student representatives (including at least one from each undergraduate year group) are invited to Departmental Teaching Committee meetings.

Students' Union Advice Service

The Students' Union Advice Service is available to UCL students. Trained and experienced caseworkers are ready to support you with any difficulties that might occur during your time at UCL. The Advice Service specialises in:

- **Academic issues** - including examination irregularities and student complaints
- **Housing** - including contract checking and housemate disputes

- **Employment** - including unpaid wages and part time employment contracts
- **Money advice** - including advice on benefits
- Many other legal and university matters

Students can make an appointment or attend a drop-in session for free, confidential and independent advice and support.

Further information:

- Students' Union Advice Service website

Student complaints

UCL aims to ensure that every student is satisfied with their experience of UCL. However we recognise that from time to time problems do arise and students may wish to express concern or dissatisfaction with aspects of UCL or the quality of services provided.

Informal resolution

Many complaints can be resolved at an informal or local level without needing to submit a formal complaint. Students can speak to their Personal Tutor, Programme Leader, Departmental or Faculty Tutor, Course Representative or Research Student Representative if they have any concerns about their programme. They can also speak to the UCL Student Mediator or the Students' Union Advice Service. UCL strongly encourages this kind of resolution and does expect students to have attempted some form of informal resolution before making a formal complaint.

Formal complaints

If an issue cannot be resolved at a local level, students may feel they need to submit a formal complaint using UCL's Student Complaints Procedure. UCL aims to ensure that all complaints are treated fairly, impartially, effectively and in a timely manner, without fear of victimisation. The Complaints Procedure applies across all Schools, Faculties, Academic Departments and Professional Service Divisions.

Further information:

- Student Complaints Procedure
- UCL Student Mediator

STUDENT FEEDBACK

UCL's goal is to put students' feedback, insights and contributions at the heart of our decision-making. We value students' feedback and work with students as partners in the process of shaping education at UCL. In recent years, as a direct result of student feedback, we extended library opening hours, opened new study spaces and scrapped graduation ticket fees for students.

The Department is very interested in how students feel about studying Statistics at UCL and how well we are doing according to the students' point of view. There are a number of ways in which students can give feedback to the Department, some of which are detailed below. Students are also encouraged to give individual feedback to their Personal Tutor (regarding general issues) and to the course lecturers (regarding specific courses). The Department will try its best to take students' opinions into account wherever possible.

Student surveys

One of the principal ways in which UCL gathers and responds to student feedback is via online student experience surveys such as the National Student Survey, The Postgraduate Taught Experience Survey and the Student Barometer. Whether it's about teaching, accommodation, or facilities, surveys are a chance for students to have their say about what works and what needs improving, to help us make sure that UCL is as good as it can be for current and future students. Each survey usually takes just a few minutes to complete, all responses are anonymous and some include a generous prize draw. Every piece of feedback is read and the results of each survey are then shared with staff right across UCL – including President & Provost Michael Arthur.

Further information:

- UCL Student Surveys

Student evaluation questionnaires

Departments also run student evaluation questionnaires on individual modules throughout the year. This gives students the opportunity to feedback about the teaching on their specific modules, helping departments to continuously improve learning, teaching and assessment. Feedback from SEQs feeds into the Annual Student Experience Review process.

The Department relies on feedback from as many students as possible in order to get a clear picture of how well the courses are running and whether improvements can be made. You will be asked to complete a questionnaire for each course that you take. This is usually done during the last two weeks of a course. You are expected to take this exercise seriously. Anonymity is preserved and space is provided on the questionnaires for additional comments if you feel that is required (positive comments are also helpful; frivolous comments will be discounted).

The Annual Student Experience Review (ASER)

UCL's Annual Student Experience Review (ASER) process requires all departments to undertake an annual self-evaluation and produce a development plan for how they plan to improve in the coming year. The self-evaluation involves looking at student feedback from surveys and student evaluation questionnaires as well as other data about student performance and academic standards, such as the feedback provided by the External Examiner, which helps departments to understand what is working well and what might need improving. Student Academic Representatives are active participants in the evaluation process and creation of the development plan through discussions at departmental and faculty committees, giving students an important role in identifying and planning improvements within their department. Students can view the completed reports and action plans on the faculty/departmental intranet.

Further information:

- Annual Student Experience Review

UCL ChangeMakers

UCL ChangeMakers encourages students and staff to work in partnership with each other on educational enhancement projects to improve the experiences of students across UCL. UCL ChangeMakers Projects supports students and staff in running projects to improve the learning experience at UCL. Anyone with an idea, or who wants get involved, can submit a

proposal for funding and support. UCL ChangeMakers ASER facilitators are students who work with Student Academic Representatives and staff in selected departments to formulate the departmental educational enhancement action plan.

Further information:

- UCL ChangeMakers

EMPLOYABILITY AND CAREERS

Careers information

Within the Department, there is a careers noticeboard in the Students' Common Room. Job advertisements and information about careers talks, fairs and courses are posted there. There are special careers talks arranged by the Careers Tutor for students from each year, including first years.

You may approach members of the academic and teaching staff for a job reference. However, please note that staff cannot supply a reference without your written permission (see page 9). If you require a reference, therefore, you should fill in a form, available from the Departmental Office and the DOSSSH Moodle page (see page 8). This form also contains space for you to provide other relevant information (for example, a description of the position / course you are applying for, and a brief CV). This kind of information will enable staff to write constructive references for you.

UCL Careers

UCL Careers provides a wide variety of careers information, one-to-one guidance and events for UCL students and recent graduates, and assists them through the entire job hunting process, including exploring options, searching for vacancies, preparing CVs and applications, practicing for interviews, aptitude tests or assessment centres, and providing access to recruitment fairs and other employment-related events. They can also advise on exploring options for further study and funding. These specialised services and events are available to graduates, international students and Master's students for up to two years following course completion.

UCL Careers also supports work-related learning, including internships and placements. UCL students who are required to complete a placement or internship as part of certain courses are supported in their search, application, and work by UCL Careers. Students can also sign up for UCL Talent Bank, a shortlisting service connecting students to small and medium sized organisations.

Further information:

- UCL Careers

Royal Statistical Society (RSS) accreditation

The Royal Statistical Society (https://www.rss.org.uk/) accredits university degree programmes at undergraduate and MSc level for a particular year on the basis of information supplied by the university. The MSc Statistics is currently accredited, meaning that Graduate Statistician (GradStat) status will automatically be granted, on application to the RSS, to holders of the MSc Statistics (including the Medical Statistics pathway) who successfully completed the taught part of the degree programme during the accredited year. Applicants must already be Fellows of the RSS or become Fellows concurrently.

The MSc Data Science programme has not yet been accredited. Graduates with this degree may apply individually for GradStat status; they will need to provide a transcript of courses taken.

Accreditation will be renewed annually subject to RSS approval of any amendments to the programmes of study and the syllabuses of constituent courses.

Entrepreneurship at UCL

UCL has a long and successful track record of supporting spin-outs and start-ups developed by its academic and student communities. Many of the student and staff entrepreneurs have won external awards and achieved substantial investment allowing their enterprises to grow and reach their full potential. UCL offers a wide range of support to students ranging from training programmes, advice on whether an idea has commercial potential, one-to-one sessions with business advisers, funding, competitions and incubator space to help them start or grow their business.

Further information:

- UCL Enterprise

UCL Global Citizenship Programme

The UCL Global Citizenship Programme is a two-week programme for UCL undergraduates and taught postgraduates offering the chance to put their studies in a global context, learn new skills and see the world differently. The Programme runs for two weeks after summer exams have finished, providing a range of opportunities to help students boost their studies, enhance their future and make an impact on the world. Participation is free and open to all UCL undergraduate and taught postgraduate students on a first come, first served basis.

Further information:

- UCL Global Citizenship Programme

HEALTH, SAFETY AND SECURITY

Health, safety and security at UCL

UCL's overall objective is to provide and maintain a safe and healthy environment for staff, students, people who work with UCL and those who visit. Health and safety is an integral part of the way in which UCL's activities are managed and conducted. The UCL Safety Services webpage includes further information about health and safety policies and useful guidance and tools for risk assessment. The UCL Security Services webpage includes information regarding security operations, emergency contacts and tips for staying safe at UCL.

Further information:

- UCL Health and Safety Policy
- UCL A-Z Safety Guidance
- General Fire Safety for UCL Students
- UCL Security Services
- Staying Safe at UCL

AFTER STUDY

Transcripts

An official transcript, detailing examinations taken and results achieved, is issued automatically to all graduating students and sent to their contact addresses as held on Portico approximately 8-10 weeks after the awards have been ratified by the UCL authorities.

UCL Student Records can produce additional transcripts for students on taught programmes as well as for affiliate students via the UCL Transcript Shop.

All graduating students will receive an official transcript, detailing examinations taken and results achieved. Transcripts are issued automatically and sent to the contact address held on Portico. Additional transcripts are available via the UCL Transcript Shop.

Further information:

- Transcripts

UCL Alumni Online Community

The UCL Alumni Online Community is a global network of more than 200,000 former students of UCL. Alumni can take advantage of a wide range of benefits, services and discounts – on campus, across the UK and globally – including the Alumni Card, access to thousands of e-journals and library services and a free UCL-branded email service. The UCL Alumni Online Community also posts information about events and reunions happening around the world and other ways to get involved, including the UCL Connect professional development series.

Further information:

- UCL Alumni

COURSE INFORMATION

The following pages give more detail, including outline syllabuses, of the core and optional courses comprising the MSc Data Science, MSc Statistics and MSc Statistics (Medical Statistics) programmes. For most courses, some indication is also given of areas where the course material may be applied in practice; this is to help students decide which options might be most suitable for them.

STATG000
FOUNDATION COURSE

Aims of course: To review the prerequisite undergraduate material assumed for the rest of the MSc degree programme.

Objectives of course: On completion of the course, a student should have reviewed and completed exercises on basic probability theory, statistical estimation and hypothesis testing, practical statistics and associated computing.

Prerequisites: Introduction to theory of probability and statistics, and the associated necessary mathematical theory.

Course content: Introduction to probability, conditional probability, random variables and distributions, expectation, special distributions, Poisson processes, Markov chains and "birth-death" processes. Introduction to estimation, sampling distributions of estimators, testing hypotheses, categorical data, non-parametric methods, linear statistical models, Minitab computing package.

Texts:
J.A. Rice: *Mathematical Statistics and Data Analysis (3rd edition)*. Duxbury Press, 2006.
S.M. Ross: *Introduction to Probability Models (8th edition)*. Academic Press, 2003.

Assessment for examination grading:
This course is not examined.

Set work:
Exercises are set with each topic. Many of these are from the book by Rice.

Timetabled workload:
About 45 hours, mainly during the week preceding and in the first week of term 1.

STATG001
STATISTICAL MODELS AND DATA ANALYSIS

Aims of course: To introduce the theory of linear and generalised linear / additive models and associated data analysis.

Objectives of course: On successful completion of the course, a student should have an understanding of the exponential family of distributions and their use in the formulation of generalised linear / additive models, and should be able to interpret the results of fitting such models in both a technical and non-technical manner.

Applications: The statistical methods introduced in STATG001 are very general, and they are used in almost all areas in which statistics is applied. In the course, we will analyse data sets from, among other areas, industrial quality control, astronomy, social sciences, and biology.

Prerequisites: STATG000. Simultaneous or previous attendance of STATG012, or its equivalent.

Course content: Multiple Linear Regression: inference techniques for the General Linear Model, applications, variable selection. Generalised Linear Models: structure incorporating an introduction to the exponential family of distributions, inference procedures. Categorical data: special cases of generalised linear models leading to logistic regression and log-linear models, use in data analysis. Introduction to non-linear modelling, mixed modelling, generalised estimating equations. Introduction to Generalised Additive Models: penalised regression splines and penalised estimation.
Course STATG003 gives students the computing skills to implement the methodology discussed in this course.

Texts:
A.J. Dobson: *An Introduction to Generalised Linear Models* (2nd edition). Chapman and Hall, 2002.
W.J. Krzanowski: *An Introduction to Statistical Modelling*. Arnold, 1998.
T. Hastie, R. Tibshirani & J. Friedman: *The Elements of Statistical Learning*. Springer, 2001.
P. McCullagh & J.A. Nelder: *Generalized Linear Models* (2nd edition). Chapman and Hall, 1989.
F. E. Harrell: *Regression Modeling Strategies*. Springer, 2001.
D. Ruppert, M. P. Wand & R. J. Carroll: *Semiparametric Regression*. Cambridge Series in Statistical and Probabilistic Mathematics, 2003.

Assessment for examination grading:
- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:
Exercises will be set during the course, which will not count towards the examination grading.

Timetabled workload:
Lectures: 2 hours per week.
Tutorials: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG002
STATISTICAL DESIGN OF INVESTIGATIONS

Aims of course: To provide an introduction to the statistical aspects relating to the design of experimental and observational studies, and to introduce associated methods of statistical analysis.

Objectives of course: On completion of the course, a student should have an

understanding of the basic ideas of experimental design and observational studies; should be able to analyse data from a variety of experimental designs by the analysis of variance; should be able to assess the appropriateness of various sampling schemes and perform appropriate analyses.

Applications: this course addresses the issues of what data are needed to answer a particular substantive question, and conversely what questions can reasonably be answered using data that may be available. These issues are fundamental to quantitative analyses in all application areas.

Prerequisites: STATG000, or simultaneous or previous attendance of STATG006.

Course content: Principles of experimental design; planning of experiments; comparative experiments; common designs: completely randomised, randomised blocks, Latin square; factorial experiments; nested and split-plot; fixed and random effects; associated analyses - analysis of variance. Observational studies v. experiments: problems of bias, confounding, difficulty of causal interpretation; planning observational studies; analysis: matching, adjusting for confounding variables; cohort studies; case-control studies. Sampling: target and sampled populations, finite populations, simple random sampling, stratification and cluster sampling, ratio and regression estimators, randomised response methods; introduction to questionnaire design.

Texts:

D.C. Montgomery: *Design and Analysis of Experiments* (5th edition). Wiley, 2000.

W.G. Cochran: *Planning and Analysis of Observational Studies*. Wiley, 1983.

V. Barnett: *Sample survey principles and methods* (2nd edition). Arnold, 1991.

Assessment for examination grading:

- Two pieces of extended coursework, one of which involves working in pairs to design, carry out and report the results of an experiment

There is no written examination. The final mark is an average of the two coursework marks (equally weighted). Students failing to submit either assessment will be declared non-complete for the course.

Other set work:
Exercises will be set during the course which will not count towards the examination grading.

Timetabled workload:
Lectures and workshops: 2 hours per week.
Tutorials: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG003
STATISTICAL COMPUTING

Aims of course: To introduce the statistical package R with particular application to statistical modelling and a selection of computational techniques.

Objectives of course: On successful completion of the course, a student should be able to use the statistical package R to input, edit and manipulate data, produce appropriate graphics and implement statistical methods taught in courses STATG001, STATG002 and STATG006. In addition, the student should be familiar with some basic principles of programming, and should be able to carry out simple programming in R with application to a variety of computational and numerical techniques.

Applications: the generic programming skills acquired in this course are applicable across a wide variety of scientific disciplines as well as in the IT sector. More specifically, the R programming environment is gaining popularity among many research communities as well as in specialised areas of business and industry, such as finance and reinsurance, where non-routine statistical analyses are increasingly required.

Prerequisites: Simultaneous or previous attendance of STATG001 or STATG006, together (in either case) with STATG002 or EPIDGS31.

Course content: Using R: expressions, assignments, objects, vectors, arrays and matrices, lists and data frames, functions, control structures, graphics. Efficiency considerations. Statistical modelling in R (in collaboration with STATG001 and STATG002): linear and generalised linear modelling, analysis of variance, residual plots,

non-linear modelling. Computational techniques: function minimisation (in particular for mle's and in non-linear modelling), quadrature, simulation (general methods, Monte Carlo). R versus S-Plus.

Texts:
B.S. Everitt: *A Handbook of Statistical Analyses using S-Plus* (2nd edition). Chapman and Hall, 2002.

Assessment for examination grading:
- Three pieces of extended coursework

There is no written examination. The final mark is a 1:2:2 weighted average of the three coursework marks. Students failing to submit either of the second and third assessments will be declared non-complete for the course.

Timetabled workload:
About 10 two-hour workshops.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG004
APPLIED BAYESIAN METHODS

Aims of course: To introduce the Bayesian approach to statistical inference, to develop relevant theory, methodology and computational techniques for its implementation and to develop basic skills in use of the WinBUGS software for Bayesian modelling.

Objectives of course: On successful completion of this course, a student should be able to give an account of the underlying principles of Bayesian inference, and contrast these with those of other schools of inference; manipulate probability formulae to derive posterior and predictive distributions; perform conjugate prior-to-posterior analysis for simple Binomial, Poisson and Normal models; analyse these and more complex Normal models, using priors representing great prior uncertainty; use hierarchical and graphical modelling to represent and analyse complex systems; describe and implement Gibbs sampling methods for estimating posterior quantities; and use WinBUGS software to estimate complex Bayesian models.

Applications: Bayesian methods are currently gaining increasing popularity, largely because advances in computing facilities and in modern simulation-based Markov Chain Monte Carlo (MCMC) methods provide a means of analysing the complex data structures that arise in application areas as diverse as artificial intelligence, biology, genetics and environmental science. This course focuses on fundamental concepts and techniques, and introduces the computational tools needed to apply Bayesian methods in challenging research-level problems.

Prerequisites: STATG000 or STATG006.

Course content: Introduction to Bayesian statistics. Bayesian inference. Prior distributions. Graphical models. Hierarchical models. Markov chain Monte Carlo (MCMC: Gibbs sampling). WinBUGS software.

Texts:
P.M. Lee: *Bayesian Statistics: An Introduction* (3rd edition), chapters 1-3. Arnold, 2004.
J. Whittaker: *Graphical Models in Applied Multivariate Statistics*, chapters 1-3. John Wiley & Sons, 1990.
C.M. Bishop: *Pattern Recognition and Machine Learning,* chapter 8. Springer, 2006.
A. Gelman, J.B. Carlin, H.S. Stern & D.B. Rubin: *Bayesian Data Analysis* (2nd edition), chapter 5. Chapman and Hall / CRC, 2003.
W.R. Gilks, S. Richardson & D.J. Spiegelhalter (eds): *Markov Chain Monte Carlo in Practice,*,chapters 1, 2 and 5. Chapman & Hall/CRC, 1996.

Assessment for examination grading:
- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:
About 5 sets of exercises. These will not count towards the examination grading.

Timetabled workload:
Lectures: 2 hours per week. Some of these may be devoted to workshops or coursework feedback.
Tutorials: 2 hours per fortnight.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG006
INTRODUCTION TO STATISTICAL DATA SCIENCE

Aims of course: To provide a general background on fundamental statistical methods and applications in data science.

Objectives of course: On successful completion of the course, students should have an understanding of the fundamental aspects of probability and statistics sufficient to follow other Masters level modules in Statistical Science. Students should also be equipped to lead basic data analysis projects in industry and research. The module will teach students: how to use probability as a language to express uncertainty; ways of visualizing and preparing data for statistical analysis; estimation techniques in the context of applied data analysis problems; the role of algorithms in the computation of estimators; how to express uncertainty in estimation via confidence intervals and hypothesis testing; predictive analysis from the point of view of regression.

Applications: The statistical methods introduced in STATG006 are very general, and they are used in almost all areas in which statistics is applied. In the course, we will discuss applications in the context of business, social sciences, and biology, among others.

Prerequisites: Knowledge of introductory probability and statistical theory, and the associated necessary mathematical theory.

Course content: Exploratory data analysis: basic visualisation for data preparation and modelling strategy. Review of probability models, in the context of the different statistical methods discussed in the course. Hypothesis testing and confidence intervals: methods for assessing the uncertainty in the analysis. Regression: linear and non-linear methods for explaining outcomes. Point estimation, maximum likelihood and basic optimization: fitting generic statistical models. Dimensionality reduction: explaining the variability in datasets using fewer dimensions.

Texts:

J.A. Rice: *Mathematical Statistics and Data Analysis (3rd edition)*. Duxbury Press, 2006.

G. James, D. Witten, T. Hastie and R. Tibshirani: *An Introduction to Statistical Learning*. Springer, 2013.

L. Wasserman: *All of Statistics: a Concise Course in Statistical Inference*. Springer, 2004.

A. Gelman & J. Hill: *Data Analysis using Regression and Multilevel/Hierarchical Models*. Cambridge University Press, 2007.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

Exercises will be set during the course, which will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Tutorials: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG009
DECISION AND RISK

Aims of course: To provide an introduction to the ideas underlying the calculation of risk from a Bayesian standpoint, and the structure of rational, consistent decision making.

Objectives of course: On successful completion of the course, a student should be able to understand special measures of risk, understand the concepts of decision theory, find appropriate probability models for risky events and check the validity of the underlying assumptions, and be familiar with methodology for detecting changes in risk levels over time.

Applications: The ideas introduced in this course provide a generic framework for thinking about risk and decision-making in the presence of uncertainty. As such, they can be applied in many diverse areas. The course will use examples from natural hazards, environmental hazards, finance, and social policy.

Prerequisites: STATG000 or STATG006.

Course content Introduction to Bayesian inference, conditional probability, Bayes's formula, expectation and utility. Elicitation of subjective probabilities and utilities. Criteria for decision making. Comparison of decision rules. Probability models for the occurrence of extreme events. Time series approaches to detecting/ modelling change in risk over time.

Texts

A. Gelman: *Bayesian Data Analysis* (3rd edition). Chapman & Hall, 2013.
J.O. Berger: *Statistical Decision Theory and Bayesian* Analysis (2nd edition). Springer, 2010.

Assessment for examination grading

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work About 4 sets of exercises. These will not count towards the examination grading.

Timetabled workload

Lectures: 2 hours per week.
Workshops: three 2 hour sessions.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG010
STOCHASTIC SYSTEMS

Aims of course: The study of random processes, with the emphasis on Operational Research applications and including queueing theory, renewal and semi-Markov processes and reliability theory.

Objectives of course: On successful completion of the course, a student should understand such concepts for stochastic processes as the Markov property, stationarity and reversibility and be able to determine whether such properties apply in straightforward examples; recognise and apply appropriately a range of models, as listed in the course contents, in a variety of applied situations so as to determine properties relevant to the particular application.

Applications: Stochastic systems arise in many areas of application. They play a fundamental role in Operational Research which addresses real-world problems through the use of mathematics, probability and statistics; topics such as queueing theory and reliability are important examples. Stochastic processes are also vital to applications in finance and insurance, and have many applications in biology and medicine, and in the social sciences. Stochastic process theory underpins modern simulation methods like Markov-chain Monte-Carlo (MCMC).

Prerequisites: STATG000, or simultaneous or previous attendance of STATG006, together (in either case) with an undergraduate introductory course in applied probability.

Course content: Markov processes: revision of general concepts, reversibility and detailed balance equations. Renewal theory and reliability: regenerative events and renewal processes, alternating renewal processes, renewal reward processes. Queues: the general single server queue, Markov queueing models (*M/M/k)*, limited waiting room, more general queues (*M/G/*1, *G/M/*1), queueing networks. Semi-Markov processes: properties and simple examples. Reliability: single repairable units, simple systems of units.

Texts:

G. Grimmett & D. Stirzaker: *Probability and Random Processes* (3rd edition). Oxford University Press, 2001.
S.M. Ross: *Introduction to Probability Models* (9th edition). Academic Press, 2007.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 4 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

About 9 sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: two 2 hour sessions.
Tutorials: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual

problems with the course, will also be provided.

STATG011
FORECASTING

Aims of course: To introduce methods of finding and extrapolating patterns in time-ordered data.

Objectives of course: On successful completion of the course, a student should be familiar with the most commonly-used models for time series; be able to derive properties of time series models; be able to select, fit, check and use appropriate models for time-ordered data sequences; understand and be able to interpret the output from the time series module of a variety of standard software packages.

Applications: Time series data take the form of observations of one or more processes over time, where the structure of the temporal dependence between observations is the object of interest. Such data arise in many application areas including economics, engineering and the natural and social sciences. The use of historical information to estimate characteristics of observed processes, and to construct forecasts together with assessments of the associated uncertainty, is widespread in these application areas.

Prerequisites: STATG000 or STATG006.

Course content: Forecasting as the discovery and extrapolation of patterns in time ordered data. Descriptive techiques for time series. Box-Jenkins models: identification, estimation, verification. Forecasting using ARIMA and structural models. Forecast assessment. State space models and Kalman Filter. Comparison of procedures. Practical aspects of forecasting. Case studies in forecasting.

Texts:

C. Chatfield: *The Analysis of Time Series: An Introduction* (5th edition). Chapman and Hall, 1996.

J.D. Cryer: *Time Series Analysis*. PWS Publishers, 1986.

A.C. Harvey: *Time Series Models* (2nd edition). Harvester Wheatsheaf, 1993.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 4 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

About 7 sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: two 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG012
STATISTICAL INFERENCE

Aims of course: To provide a grounding in the theoretical foundations of statistical inference and, in particular, to introduce the theory underlying statistical estimation and hypothesis testing.

Objectives of course: On successful completion of the course, a student should be able to: describe the principal features of, and differences between, frequentist, likelihood and Bayesian inference; define and derive the likelihood function based on data from a parametric statistical model, and describe its role in various forms of inference; define a sufficient statistic; describe, calculate and apply methods of identifying a sufficient statistic; define, derive and apply frequentist criteria for evaluating and comparing estimators; describe, derive and apply lower bounds for the variance of an unbiased estimator; define and derive the maximum likelihood estimate, and the observed and expected information; describe, derive and apply the asymptotic distributions of the maximum likelihood estimator and related quantities; conduct Bayesian analyses of simple problems using conjugate prior distributions, and asymptotic Bayesian analyses of more general problems; define, derive and apply the error probabilities of a test between two simple hypotheses; define and conduct a likelihood ratio test; state and apply the Neyman-Pearson lemma;

Applications: The theory of statistical inference underpins statistical design,

estimation and hypothesis testing. As such it has fundamental applications to all fields in which statistical investigations are planned or data are analysed. Important areas include engineering, physical sciences and industry, medicine and biology, economics and finance, psychology and the social sciences.

Prerequisites: STATG000.

Course content: Frequentist and Bayesian approaches to statistical inference. Summary statistics, sampling distributions. Sufficiency, likelihood, and information. Asymptotic properties of estimators. Bayesian inference. Hypothesis testing. Likelihood ratio tests, application to linear models.

Texts:

D.R. Cox: *Principles of Statistical Inference*. Cambridge University Press, 2006.

P.H. Garthwaite, I.T. Jolliffe & B. Jones: *Statistical Inference* (2nd edition). Oxford University Press, 2002.

P.M. Lee: *Bayesian Statistics: An Introduction* (2nd edition). Arnold, 1997.

J.A. Rice: *Mathematical Statistics and Data Analysis* (3rd edition). Duxbury, 2006.

G.A. Young and R.L. Smith: *Essentials of Statistical Inference*. Cambridge University Press, 2005.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

About 8 sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: 2 two-hour classes.
Tutorials: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG015
MEDICAL STATISTICS I

Aims of course: To provide an introduction to the fields of clinical trials and epidemiology, with emphasis on the statistical ideas and methodology most widely used in these areas.

Objectives of course: On successful completion of the course, a student should have an understanding of ways to measure health outcomes, types of observational studies and their design issues, and design features of randomised trials. In addition they should be able to implement and interpret results from basic methods of analysis used in health studies as well as logistic regression and methods for analysis of survival data

Applications: This course, together with STATG016, has applications in both medicine and epidemiology. Important areas include the design and analysis of medical research studies, including randomised controlled trials.

Prerequisites: STATG000. Simultaneous or previous attendance of STATG001 and STATG012, or its equivalent.

Course content: The role of medical statistics; Types of observational studies: case-control, matched case-control, cohort, cross-sectional and their analysis: introducing absolute and relative measures of risk, rates and odds; Design features of randomised trials: randomisation, blocking, stratification, minimisation, blinding, use of placebos; Survival analysis: features of survival data, hazard and survivor functions, censoring, Kaplan Meier Curves, Log rank Tests, Cox regression; Analysis of parallel group trials: basic analysis, intention to treat and per protocol analyses, missing data, use of baseline data, subgroup analyses, interpretation of results; Confounding and interaction: concepts of confounding and interaction, stratification and matched analysis; Logistic regression: odds ratios, predictions, multiple logistic regression, categorical and continuous covariates, assumptions of linearity, interactions, goodness of fit (Hosmer-Lemeshow), conditional logistic regression; Calculation of sample size for trials and observational studies; Introduction to statistical software STATA. *There will be computer or paper based practical sessions on analysis of observation studies, study design, analysis of trials, confounding and interaction, survival analysis, logistic regression and sample size calculation.*

Texts:
B.R. Kirkwood & J.A.C. Sterne. *Essential Medical Statistics* (2nd edition, 2003, Blackwell).
S.J.Pocock. *Clinical Trials. A Practical Approach* (1983, Wiley).
K.J.Rothman & S.Greenland, *Modern Epidemiology* (3rd edition, 1998, Lipinncott, Williams & Wilkins).
D. Collett. *Modelling Binary Data* (2nd edition, 2003, Chapman and Hall)
D.Collett. *Modelling Survival Data in Medical Research* (2nd edition, 2003, Chapman and Hall).
D.Clayton and M.Hills. *Statistical Models in Epidemiology* (1993, Oxford).

Assessment for examination grading:
- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:
Several sets of exercises. These will not count towards the examination grading.

Timetabled workload:
Lectures: 2 hours per week.
Workshops: two 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG016
MEDICAL STATISTICS II

Aims of course: To provide a continuation of the study of medical statistics started in STATG015, with emphasis on more advanced topics in epidemiological methods and the design and analysis of clinical trials.

Objectives of course: On successful completion of the course, a student should be able to: model survival data using parametric regression models; develop and validate a risk prediction model; analyse clustered data using a regression model; design and analyse a cross-over trial, cluster randomised trial, equivalence trial and early phase trial; understand the issues concerning interim analyses and missing data; carry out a meta-analysis.

Applications: This course, together with STATG015, has applications in both medicine and epidemiology. Important areas include the design and analysis of medical research studies, including randomised controlled trials.

Prerequisites: STATG015, or its equivalent.

Course content: Modelling survival data using parametric models. Risk prediction models, Introduction to clustered data including cluster randomised trials, repeated measures and GEEs. Hierachical regression models for continuous, binary and survival outcomes. Interim analyses in trials. Equivalence trials. Cross over trials. Early phase trials. Systematic reviews and meta-analysis. Missing data. *In addition, there will be weekly practical sessions on many of the topics listed above.*

Texts:
B.R. Kirkwood & J.A.C. Sterne: *Essential Medical Statistics*. Blackwell.
D. Collett: *Modelling Survival Data in Medical Research*. Chapman and Hall.
E.W. Steyerberg: *Clinical Prediction Models*. Springer, 2010.
T.A.B. Snijders & R Bosker. *Multilevel Analysis*. Sage.
H. Goldstein: *Multilevel Statistical Models*. Wiley.
J.W. Hardin & J.M. Hilbe: *Generalized Estimating Equations*. CRC Press.
S.J. Pocock: *Clinical Trials. A Practical Approach*. Wiley, 1983.
A. Whitehead: *Meta-Analysis of Controlled Clinical Trials*. Wiley, 2008.

Assessment for examination grading:
- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:
Several sets of exercises. These will not count towards the examination grading.

Timetabled workload:
Lectures: 2 hours per week.
Workshops: two 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG017
STOCHASTIC METHODS IN FINANCE I

Aims of course: To introduce mathematical concepts and tools used in the finance industry, in particular stochastic models and techniques used for financial modelling and derivative pricing.

Objectives of course: On successful completion of the course, a student should have a good understanding of how financial markets work, be able to describe basic financial products, have a good knowledge of the basic mathematical and probabilistic tools used in modern finance, including stochastic calculus, and be able to apply the relevant techniques for the pricing of derivatives.

Applications: The techniques taught in this course are widely used throughout the modern finance industry, including the areas of trading, risk management and corporate finance. They also have applications in other areas where investment decisions are made under uncertainty, for example in the energy sector where decisions on whether or not to build (i.e. invest in) new power plants are subject to uncertainty regarding future energy demand and prices.

Prerequisites: STATG000, or simultaneous or previous attendance of STATG006.

Course content: Financial markets, products and derivatives. The time value of money. Arbitrage Pricing. The binomial pricing model. Brownian motion and continuous time modelling of asset prices. Stochastic calculus. The Black-Scholes model. Risk-neutral pricing. Extensions and further applications of the Black-Scholes framework.

Texts:

J. Hull: *Options Futures and Other Derivative Securities*. Prentice Hall, 2000.

M. Baxter & A. Rennie: *Financial Calculus*. Cambridge University Press, 1996.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: four 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG018
FACTORIAL EXPERIMENTATION

Aims of course: To introduce 2^k experiments, fractions and blocking. To introduce designs for response surface modelling. To discuss experimental designs to achieve quality control, including Taguchi ideas.

Objectives of course: On completion of the course, a student should have an understanding of the basic ideas relating to 2^k factorial experiments, including for fractional designs and with blocking; should be able to analyse data from these experiments by the analysis of variance and/or graphical techniques; be able to design experiments for response surface modelling; be able to understand and use practical aspects of experimental design including randomisation.

Applications: Factorial experiments are useful in any situation in which a complex system has to be investigated or optimised. The applications tend to be in the fields of science and technology, though that may be a result of a lack of imagination rather than a lack of wider applicability. Some examples are the optimisation of an industrial production process, the design of a new drug, the design of a human-computer interface, the optimisation of products and marketing campaigns, computer simulations to explore the effect of interventions on, e.g., economy or climate, or the quality of new statistical methodology.

Prerequisites: STATG002 and either STATG001 or STATG006.

Course content: Experiments: What is an experiment? Advantages over observational studies. Importance of randomisation. 2^k factorials: Advantages over one-at-a-time experiments. Interactions, two-factor and higher order. Estimation of effects including relation with regression and orthogonality of X^TX matrix. Estimation of error using replication and using pre-specified

interactions. ANOVA table and relation of sums of squares to effect estimates. Warning about dangers of error estimation using smallest effects. Using normal and half-normal plots for analysis. Fractional factorials, aliasing, choosing a design. Blocking. Model checking and diagnostics. Response surfaces: 3^k, central composite and Box-Behnken designs. Fitting polynomial response surfaces. Taguchi's ideas: quality = lack of variability, control and noise factors, exploiting interactions to reduce process variability.

Texts:

D.C. Montgomery: *Design and Analysis of Experiments* (5th edition). Wiley, 2000.
G.K. Robinson: *Practical Strategies for Experimenting*. Wiley, 2000.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 4 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

About 8 sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: 2 two-hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG019
SELECTED TOPICS IN STATISTICS

Aims of course: To provide an introduction to, and practical experience of, key ideas in selected specialized topics that are at the forefront of developments in modern statistical research and practice. The module is aimed specifically at students who may be considering going on to do research in statistics or related areas.

Objectives of course: On successful completion of the module, students should be able to: explain the motivation for, and key ideas involved, in the topics that have been studied; identify situations in which the studied techniques are potentially applicable, while recognizing their potential limitation; use software packages that are available in R to apply the techniques to real-world examples where appropriate; and understand the context of research papers in the areas that have been studied.

Applications: the availability of huge and often complex data sets, coupled with cheap computing power makes it possible to contemplate analyses that were inconceivable even two decades ago. The development of statistical methodology has made full use of these opportunities, so that modern statistics has made significant contributions in a wide range of application areas. The material covered in this course will vary from year to year so that the specific applications will vary; however, it will provide students with some insight into the state of the art. As such it would be suitable for students contemplating research in statistics or, indeed, in any other subject where complex problems require the use of advanced statistical methods.

Prerequisites: STATG001 or both STATG006 and COMPGI21. STATG003.

Course content: This course will provide an introduction to two or three advanced topics in modern statistics. The precise topics covered will vary from year to year, depending on teaching staff availability and research interests. Examples of topics might include: bootstrap and related methods; extreme value theory; multivariate analysis; nonparametric smoothing; robust methods; spatial statistics; applied probability; and estimating functions. Where appropriate, the methods will be illustrated using software available in the R package.

Topic 1: Cluster Analysis (Dr CM Hennig)
Cluster analysis is about finding groups of observations in data. It has a very wide range of applications such as delimitation of species in biology, data compression, classification of diseases or mental illnesses, market segmentation, detection of patterns of unusual internet use, classification of regions or countries for administrative use, object identification in images etc. In the internet age, much data is routinely collected, and many such datasets are heterogeneous and chaotic. Cluster analysis is often used as a first exploratory tool to find better manageable subgroups, or more generally, to find unexpected patterns in datasets.

In the course, three basic approaches of cluster analysis will be introduced, namely

defining clusters by optimal centroid objects, statistical mixture models, and hierarchical distance-based methods. A general idea of clustering is that objects in a cluster should be similar to each other, and distant from objects in other clusters. The course will therefore introduce some measurements of similarity and distance that can be applied to various data types (e.g., data with continuous, categorical or mixed variables). Furthermore, the tricky issue of estimating or deciding the number of clusters will be treated, along with techniques to check the validity and to visualise clusterings.

Data examples will be given and it will be explained how to use R for running the introduced analyses. Knowledge of R (STATG003) and of basic statistical modelling as introduced in STATG001 or STATG006 is required. The following texts are relevant to this part of the course:

B.S. Everitt, S. Landau, M. Leese & D. Stahl: *Cluster Analysis* (5th edition). Wiley, 2011.
L. Kaufman & P.J. Rousseeuw: *Finding Groups in Data - an Introduction to Cluster Analysis*. Wiley, 1990/2005.

Topic 2: Model validation, model selection and model comparison (Dr FJ Király)
The recent “big data” revolution has seen a surge of interest in machine learning strategies such as neural networks (aka deep learning), kernel learning, or ensembling, contributing to an ever-growing method zoo to choose (or not to choose) from. This naturally leads to the question of what would be a sensible way to do so, and how to check whether the chosen modelling strategies are sensible. More precisely, how to quantitatively assess the performance of strategies on a given dataset of interest, and how to choose a method to deploy in a practical setting where one may have to trade-off interpretability against computational cost against accuracy – a deep neural network run on a large computational cluster may not always be preferable above simple linear regression (or above always predicting the number 42).

The course will introduce the basic concepts of model-external model assessment for supervised classification and regression tasks, highlighting connections to meta-modelling and model tuning, while introducing the proper mathematical setting in which model-agnostic model appraisal and model selection can be studied, including the statistical guarantees which can (or cannot) be given (STATG001 or COMPGI21 level familiarity with predictive/supervised modelling strategies is required). Later parts of the course will give an overview on results, limitations and open research questions in validation of unsupervised methodology (e.g., clustering), probabilistic modelling (e.g., Bayesian), or time series related tasks (e.g., forecasting).

The course content will be illustrated by workshop content using the R or python languages (basic level working knowledge in one of the two will be required), accompanied by overviews of the most frequently employed method classes for the mentioned tasks, together with a hands-on guide on their use (and appropriateness) in general data analytics and model validation workflows in state-of-art machine learning environments. The following texts are relevant to this part of the course:

S. Arlot, A. Celisse: *A survey of cross-validation procedures for model selection*. Statistics Surveys, Vol. 4 (2010) 40–79.
Y. Grandvalet, Y. Bengio: *Hypothesis testing for cross-validation*. Technical Report 1285, D´epartement d’Informatique et Recherche Op´erationnelle, 2006.
N, Japkowicz, M. Shah: *Evaluating learning algorithms – a classification perspective*. Cambridge University Press, 2011.
A. Vehtari, J. Ojanen: *A survey of Bayesian predictive methods for model assessment, selection and comparison*. Statistics Surveys, Vol 6 (2012), 142-228.

Assessment for examination grading:
- Two pieces of extended coursework (one for each topic)

There is no written examination. The final mark is an average of the two coursework marks (equally weighted). Students failing to submit either assessment will be declared non-complete for the course.

Other set work:
Several sets of exercises. These will not count towards the examination grading.

Timetabled workload:
Lectures: 2 hours per week.
Workshops: eight 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG020
STOCHASTIC METHODS IN FINANCE II

Aims of course: To explore advanced topics in finance via mathematical and statistical methods in order to gain a better understanding of optimal decision making, risk management and derivative pricing techniques. The course will be built on material covered in STAT3006.

Objectives of course: On successful completion of the course, a student should be able to: Define the concepts of risk aversion and stochastic dominance, and apply them to manage risk in, and rank capital projects; Understand how dynamic programming can be used to make optimal decisions under uncertainty; Understand how to apply mathematical and statistical modelling techniques to credit risk modelling, value-at-risk measurements and capital adequacy assessments; Understand a range of modelling techniques used in derivative pricing, and the concepts and assumptions that underpin them; Criticise and understand the limitations of these techniques as they are used in the modern finance industry.

Applications: The techniques taught in this course are widely used throughout the modern finance industry, including the areas of: business investments decisions (for example in the energy sector where decisions on whether or not to invest in and build new power plants are subject to uncertainty regarding future energy demand and prices); in corporate finance; in trading activities in the financial markets; in financial and other forms of risk management; in valuing and accounting for assets; and in the prudential regulation of the banking industry.

Prerequisites: STATG017, or its equivalent.

Course content: Utility theory; Real options, including dynamic programming, optimal investment rules, and managerial flexibility; Risk management, including value-at-risk and credit risk modelling; More advanced techniques in derivative pricing.

Texts:

J.Hull: *Options Futures and Other Derivative Securities*. Prentice Hall, 2000.

M. Baxter & A. Rennie: *Financial Calculus*. Cambridge University Press, 1996.

A.K. Dixit & R.S. Pindyck: *Investment under Uncertainty*. Princeton University Press, 1994.

P. Wilmott: *Wilmott Introduces Quantitative Finance*. Wiley, 2007.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

Several sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: 2 two-hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided

STATG021
BAYESIAN METHODS IN HEALTH ECONOMICS

Aims of course: To provide an introduction to Bayesian analysis and Markov Chain Monte Carlo (MCMC) methods using R and MCMC sampling software (such as BUGS or JAGS), as applied to cost-effectiveness analysis and the typical models used in health economic evaluations. Emphasis will be placed on the practical side of Bayesian inference.

Objectives of course: The course is targeted at students interested in decision modelling and in the practice of Bayesian analysis in health economics. However, the topics and statistical content are fairly general and applicable to other areas (e.g. economics, biostatistics, epidemiology). On successful completion of the course, a student should be able to: i) understand the basic concepts of Bayesian analysis; and ii) design, build, run and interpret the results of a Bayesian model, with specific application to health economic problems. These skills are widely transferrable to a variety of fields and applications.
The course will be based on a mixture of lectures and computer practicals. Specific topics include an introduction to health economics, a review of a range of probability distributions, regression analysis, Markov models and random-effects meta-analysis.

Applications: This course has applications in medicine and studies on public health, epidemiology and health services research.

Prerequisites: STATG001 and STATG012, or its equivalent.

Course content: The course syllabus includes the following topics: Introduction to health economic evaluations; Introduction to Bayesian inference; Introduction to MCMC in BUGS/JAGS; Analysis of cost and cost-utility data; Statistical cost-effectiveness analysis; Probabilistic Sensitivity Analysis (PSA); Evidence synthesis and hierarchical models; Decision-analytic and Markov models.
The practical sessions are based on a combination of R and BUGS and topics include: Monte Carlo estimation in BUGS; MCMC estimation in BUGS; Cost-effectiveness analysis with individual level data; Introduction to R and cost-effectiveness analysis using the R package BCEA; Health economic evaluation and PSA with R/BUGS/BCEA; Advanced topics in PSA in R using BCEA; Evidence synthesis (1): decision models; Evidence synthesis (2): network meta-analysis; Markov models in health economics.

Texts:

G. Baio: *Bayesian Methods in Health Economics* (and references therein). CRC Press, 2013.

A. Briggs, M. Sculpher & K. Claxton: *Decision Modelling for Health Economic Evaluation*. Oxford University Press, 2006.

D. Lunn, C. Jackson, N. Best, A. Thomas & D. Spiegelhalter: *The BUGS Book*. CRC Press, 2014.

D. Spiegelhalter, K. Abrams & J. Myles: *Bayesian Approaches to Clinical Trials and Health Care Evaluation*. Wiley, 2004.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

Several sets of practical exercises involving R and BUGS. These will not count towards the examination grading.

Timetabled workload:

Lectures: 1 hour per week.
Workshops: 1 hour per week.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG022
QUANTITATIVE MODELLING OF OPERATIONAL RISK AND INSURANCE ANALYTICS

Aims of course: To develop a core mathematical and statistical understanding of an important new emerging area of risk modelling known as Operational Risk which arose from the development of the Basel II/III banking regulatory accords. This will equip students with the necessary tools to undertake core modelling activities required in risk management, capital management and quantitative modelling in modern financial institutions.

Objectives of course: On completion of the course, a student should be able to: describe the key quantitative requirements of the Basel II/III banking accord; describe the 56 risk cells (business units and risk types) required under the standard Basel II/III regulator frameworks; describe the basic indicator, standardized and advanced measurement approaches; describe the key components of a loss distributional approach model; develop frequency and heavy tailed severity models for Operational risk types including estimation or the model parameters and model selection; describe properties and asymptotic estimators for risk measures that are required for capital calcultion; describe the coherent allocation of capital to business units from the institutional level; introduce and understand the influence of dependence modelling within an LDA model structure; obtain familiarity with particular classes of copula statistical models of basic relevance to practical Operational risk modelling; decide upon appropriate combining approaches for different sources of data required by regulation to be considered in OpRisk settings; develop loss aggregation methods to aggregate OpRisk loss processes.

Applications: An integral part of modern financial risk involves Operational Risk, the third key risk type that financial institutions must model and hold capital for according to the international banking regulations of Basel II/III. The key set of concepts and

mathematical modelling tools developed in this course will equip the future risk modellers and quantitative analysts with the appropriate core mathematical and statistical background to undertake development of such risk models in industry.

Prerequisites: Familiarity with distribution theory and generating functions, for example as encountered in STATG000 or STATG006. Also some basic experience in either Matlab, Python or R is needed, as taught in STATG003, or its equivalent.

Course content: Key components of operational risk frameworks, external databases, scenario analysis, operational risk in different financial sectors, risk organization and governance. Basic indicator approach, standardized approaches, advanced measurement approach. Loss distributional approach: quantiles and moments, frequency distributions, severity distributions and heavy tailed models, convolutions and characteristic functions, basic asymptotics of compound processes, modelling truncated and censored data constant threshold Poisson process, negative binomial and binomial processes, effects of ignoring data truncation, time varying thresholds, stochastic unobserved thresholds. Measures of risk: coherent and convex risk measures, comonotonic additive risk measures, value-at-risk, expected shortfall, spectral risk measures, distortion risk measures, risk measures and parameter uncertainty. Capital Allocation: coherent capital allocation, Euler allocation, allocation of marginal contributions, estimation of risk measures and numerical approximations. Modelling dependence: dependence modelling in the LDA framework, dependence between frequencies, dependence between severities, dependence between annual losses, common factor models, copula modelling. Combining different data sources: internal, external and expert opinions, Bayesian methods, minimum variance, credibility methods. Loss aggregation: calculation of the annual loss distribution, calculation of the institution wide annual loss.

Texts:

M.G. Cruz, G.W. Peters & P.V. Shevchenko: *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk*. Wiley, 2014.

G.W. Peters & P.V. Shevchenko: *Advances in Heavy Tailed Risk Modelling: A Handbook of Operational Risk*. Wiley, 2014.

M.G. Cruz: *Modelling, Measuring and Hedging Operational Risk.* The Wiley Finance Series, 2002.

M.G. Cruz (Editor): *Operational Risk Modelling and Analysis: Theory and Practice*. RISK, 2004.

G.N. Gregoriou: *Operational Risk Towards Basel III: Best Practices and Issues in Modelling, Management and Regulation*. Wiley Finance, 2011.

Assessment for examination grading:

- In-course assessment (see page 29)
- 2 hour written examination

The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:

About 8 sets of exercises. These will not count towards the examination grading.

Timetabled workload:

Lectures: 2 hours per week.
Workshops: two 2 hour classes.
Office hours, during which the lecturer will be available to discuss students' individual problems with the course, will also be provided.

STATG099
PROJECT

Aims of course: To enable students to apply Statistical Science to real world problems and to present their findings in a written report.

Objectives of course: On successful completion of the course, a student should be able to plan a suitable schedule for completing an extended project; obtain or access relevant background information and data; select and apply appropriate formal and informal statistical methods, using computer software as appropriate; assess what has been achieved and point to further research; use appropriate word processing skills to write up a project dissertation efficiently; and communicate findings both technically and non-technically, in a word processed dissertation and an oral presentation.

Prerequisites: Relevant material from other courses in the MSc programme.

Assessment for examination grading:
Dissertation (normally between 10000-12000 words, i.e. about 30 pages, A4 size, double-spaced typing, excluding graphs, tables, computer programmes and other output), to be submitted by the start of September. Over-length reports will be penalised (see page 30).
Oral presentation (15 minutes excluding questions) at the start of September.
The final mark is a 4 to 1 weighted average of the dissertation and presentation marks.

Timetabled workload
Skills development: Preparation for the project starts with several practical exercises, presented and discussed in workshop sessions during terms 1 and 2. Topics include preparing and presenting short talks, presenting information in tabular and graphical form, reading and digesting other people's research, and the use of the document preparing system LaTeX. Participation in these activities is mandatory although it does not count towards the assessment for the course: any student whose participation is inadequate will be declared non-complete for the course.
Tutorials: about once a week, starting in June.
Individual study: full-time, starting in June.

COMPGI08
GRAPHICAL MODELS

Information on this course is available from the following webpage: http://www.cs.ucl.ac.uk/current_students/syllabus/compgi/compgi08_graphical_models/.

COMPGI15
INFORMATION RETRIEVAL & DATA MINING

Information on this course is available from the following webpage: http://www.cs.ucl.ac.uk/current_students/syllabus/compgi/compgi15_information_retrieval_data_mining/.

COMPGI17
AFFECTIVE COMPUTING AND HUMAN-ROBOT INTERACTION

Information on this course is available from the following webpage: http://www.cs.ucl.ac.uk/current_students/syllabus/compgi/compgi17_affective_computing_and_human_robot_interaction/.

COMPGI19
STATISTICAL NATURAL LANGUAGE PROCESSING

Information on this course is available from the following webpage: http://www.cs.ucl.ac.uk/current_students/syllabus/compgi/compgi19_statistical_natural_language_processing/.

COMPGI21
INTRODUCTION TO MACHINE LEARNING

Information on this course is available from the following webpage: http://www.cs.ucl.ac.uk/current_students/syllabus/compgi/compgi21_introduction_to_machine_learning/.

EPIDGS31
EPIDEMIOLOGY

Information on this course is available from the following webpage: http://www.ucl.ac.uk/iehc/study/postgraduate_taught/mschealthsociety/modules/core-modules/epidemiology.

GENEG005
STATISTICS FOR INTERPRETING GENETIC DATA

Information on this course is available from the UCL Division of Biosciences: https://www.ucl.ac.uk/biosciences/.

The information given in this document is as far as possible accurate at the date of publication but the Department reserves the right to amend it.

Department of Statistical Science, UCL, September 2017.