Courses in Statistical Science for Undergraduates on Other Degree Programmes

2016/17
Who should use this document?

This document provides a guide to optional courses offered by the Department of Statistical Science for:

- Undergraduates from other UCL departments (except for students from Mathematics and Computer Science, for whom other arrangements are made).
- Undergraduates registered for the Natural Sciences or the Human Sciences degree programmes (except Natural Sciences students taking the “Mathematics and Statistics” stream, for whom other arrangements are made).

This document is not intended for use by the following students:

- Students registered on Mathematics degree programmes. A separate handbook: Courses in Statistical Science for Mathematics Undergraduates is provided for these students.
- Students registered for the first year of the BA Economics and Business with East European Studies degree programme, for whom separate arrangements are made (details are available from the School of Slavonic and East European Studies).
- Students registered for the second year of Computer Science degree programmes, for whom separate arrangements are made (details of course COMP206P Mathematics and Statistics are available from the Computer Science Department).
- Students registered on undergraduate affiliate programmes who are enrolled at UCL during the autumn term only. None of the courses offered by the Department of Statistical Science are suitable for these students (because the final examinations do not take place until the summer term).

Courses Available

The courses described below fall into two categories:

- Service courses specially provided for students from other departments
- Departmental courses offered to our own undergraduates that are also suitable for students from other departments.

Syllabuses for all courses are given at the end of the document. The courses are all 0.5 units. In most cases, prerequisites equivalent to those stated are acceptable.

Service Courses

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Title</th>
<th>Code</th>
<th>Level</th>
<th>Term</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2</td>
<td>Introductory Statistical Methods &amp; Computing</td>
<td>STAT6101</td>
<td>First</td>
<td>1 or 2</td>
<td>GCSE Maths</td>
</tr>
<tr>
<td>1</td>
<td>Introductory Statistical Methods (A)</td>
<td>STAT6102</td>
<td>First</td>
<td>1 &amp; 2</td>
<td>GCSE Maths</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Further Statistical Methods &amp; Computing¹</td>
<td>STAT7101</td>
<td>Intermediate</td>
<td>1</td>
<td>STAT6101 or STAT6102</td>
</tr>
</tbody>
</table>

¹ STAT7101 may not be taken by students from the Mathematics or Economics departments. Students from these departments should register for course STAT2002 instead (see below).
Departmental Courses

<table>
<thead>
<tr>
<th>Year</th>
<th>Course Title</th>
<th>Code</th>
<th>Level</th>
<th>Term</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2</td>
<td>Introduction to Probability &amp; Statistics</td>
<td>STAT1004</td>
<td>First</td>
<td>1</td>
<td>A-level Maths (grade A)</td>
</tr>
<tr>
<td>1 or 2</td>
<td>Further Probability &amp; Statistics</td>
<td>STAT1005</td>
<td>First</td>
<td>2</td>
<td>STAT1004</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Linear Models &amp; the Analysis of Variance²</td>
<td>STAT2002</td>
<td>Intermediate</td>
<td>1</td>
<td>STAT1004 &amp; STAT1005, or ECON2007</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Social Statistics</td>
<td>STAT7002</td>
<td>Intermediate</td>
<td>2</td>
<td>STAT2001 or ECON2007</td>
</tr>
<tr>
<td>3</td>
<td>Optimisation Algorithms in Operational Research Forecasting</td>
<td>STAT7003</td>
<td>Advanced</td>
<td>1</td>
<td>See below footnote³</td>
</tr>
<tr>
<td>3</td>
<td>Decision &amp; Risk</td>
<td>STAT3004</td>
<td>Advanced</td>
<td>2</td>
<td>STAT1005 or ECON2007</td>
</tr>
<tr>
<td>3</td>
<td>Stochastic Methods in Finance I</td>
<td>STAT3006</td>
<td>Advanced</td>
<td>1</td>
<td>STAT2001 or ECON2007</td>
</tr>
<tr>
<td>3</td>
<td>Quantitative Modelling of Operational Risk &amp; Insurance Analytics</td>
<td>STAT3022</td>
<td>Advanced</td>
<td>2</td>
<td>STAT2001 or ECON2007, &amp; STAT7001</td>
</tr>
</tbody>
</table>

Advice and registration

The Department of Statistical Science is located on the first and second floors of 1-19 Torrington Place. The offices of the staff named on page 3 are in this location.

With the exception of courses STAT6101 *Introductory Statistical Methods and Computing* and STAT6102 *Introductory Statistical Methods (A)*, *BEFORE* registering for a course on Portico, students *MUST* consult a member of the Statistical Science staff, who will determine whether they have the necessary academic prerequisites. The registration procedure is as follows:

**Course STAT6101**

Any student with GCSE Mathematics or equivalent may register for this module on Portico. All such registrations will be approved automatically by the Statistical Science Department.

**Course STAT6102**

Any student on a BA “Language with/ and Management” degree with GCSE Mathematics or equivalent may register for this course on Portico. All such registrations will be approved automatically by the Statistical Science Department. Students on other degree programmes should not opt for this course without consulting a member of staff in the Department of Statistical Science (see below): in general they should opt for STAT6101 instead.

Prospective students should be aware that STAT6102 is a core module for the BA *Economics and Business with East European Studies* degree programme, for which A level Mathematics (or equivalent) is an entry requirement. The course is designed to be accessible to students without A level Mathematics, but such students may find the material

² Students with non-mathematical backgrounds should register for STAT7101 (see “Service courses” above) rather than STAT2002.
³ For STAT7003, it is preferable for a student to have done some further study of Mathematics since starting their degree programme. Some introductory probability is also required (e.g. STAT6101).
challenging and they will need to put in an appropriate amount of self-study to stay on top of it. As a guideline, the Department of Statistical Science expects all students to study for at least the same amount of time outside the classroom as in it – for STAT6102, this means at least two hours per week of self-study throughout terms 1 and 2. Students who are concerned about their preparedness for this course should discuss the matter in the first instance with their programme tutor in their home department.

**All other courses**

- **During the first week of term 1,** see:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Staff Member</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 26 September</td>
<td>12:00 – 14:30</td>
<td>Dr Matina Rassias</td>
<td>134</td>
</tr>
<tr>
<td>Tuesday 27 September</td>
<td>13:00 – 15:30</td>
<td>Dr Matina Rassias</td>
<td>134</td>
</tr>
<tr>
<td>Wednesday 28 September</td>
<td>13:00 – 15:30</td>
<td>Dr Matina Rassias</td>
<td>134</td>
</tr>
<tr>
<td>Thursday 29 September</td>
<td>14:00 – 17:00</td>
<td>Dr Ricardo Silva</td>
<td>139</td>
</tr>
<tr>
<td>Friday 30 September</td>
<td>14:00 – 17:00</td>
<td>Dr Christian Hennig</td>
<td>129</td>
</tr>
</tbody>
</table>

- **After the first week of term 1,** see Dr Matina Rassias (room 134) during her regular office hours (Mondays 11:00-12:00, Wednesdays 09:30-10:30 and Fridays 15:00-16:00).

To register after this discussion, use the Portico system. Ensure that any course codes you select correspond exactly to those given in the above lists. **Registrations will NOT be approved unless they have been agreed with the Department beforehand.** Also, for some courses the Department can only accommodate students up to a certain maximum number, and no further registrations will be approved once this maximum is reached.

**For general advice**

For general advice and information about statistics courses, including STAT6101, consult a member of the Statistical Science staff (details as above).

**Teaching arrangements**

The service courses STAT6101 and STAT6102 are taught through compulsory workshops. STAT6102 is taught throughout terms 1 and 2. Detailed arrangements for STAT6101 are given below.

The remaining courses on offer consist of lectures supplemented by at least one of the following: tutorials, workshops, problem classes. Workshops are also referred to as "practical classes" in some departmental literature. The proportions of these activities vary between courses; details are provided in the next section.

**Monitoring attendance and progress**

Students' attendance at tutorials and workshops will be monitored. Unsatisfactory attendance at these classes or an unsatisfactory coursework record will be reported to a student's Departmental Tutor. An indication of the amount of set work for each course is provided in the final section of this document.

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 course mark. **More stringent requirements are in place for some courses (see course descriptions at the end of this document).**
**Timetable**

**STAT6101:** This course is taught in four separate groups, scheduled as follows.

<table>
<thead>
<tr>
<th>Group</th>
<th>Term</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Wednesdays 11:00-13:00, Fridays 09:00-11:00</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>Tuesdays 14:00-16:00, Thursdays 14:00-16:00</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>Tuesdays 09:00-11:00, Fridays 11:00-13:00</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>Wednesdays 11:00-13:00, Fridays 09:00-11:00</td>
</tr>
</tbody>
</table>

Students will be allocated automatically to one of these groups within 24 hours of registration on Portico, to fit around the timetable for their other courses and subject to room size constraints. **Students must NOT change from their allocated group without the prior agreement of the course organiser.** Details of room locations for each group will be available from [http://www.ucl.ac.uk/timetable](http://www.ucl.ac.uk/timetable).

**Other course units:** Course timetables are available from [http://www.ucl.ac.uk/timetable](http://www.ucl.ac.uk/timetable), usually from mid-August onwards. After making your module selections on Portico, tutorial allocation for Statistical Science courses will be arranged by the 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.**

**Teaching dates:**
- Lectures and workshops for all Statistical Science courses start in week 2 of term 1.
- Term 2 lectures and workshops begin on the first day of term.
- Teaching for all Statistical Science courses continues until the last day of each term.

**Examinations**

For most courses, you are examined by a combination of in-course assessment and written examination. The final mark is obtained by combining the in-course assessment mark and the written examination mark. For each course described later in this handbook, a guideline is given to indicate the scheme used for combining marks. To pass a course, a final mark of at least 40% is required.

**In-course assessment**

At the beginning of each course, the lecturer will provide details of the method and dates of any in-course assessment. 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.

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 and students should respect the lecturers’ time by confining queries to these hours.

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4 Guidance on what constitutes plagiarism (and collusion) is also available from the [Department of Statistical Science Undergraduate Student Handbook](http://www.ucl.ac.uk/timetable).
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. You will also need to submit your work in a single securely stapled bundle including the cover sheet.

**Deadlines**

The Department of Statistical Science aims to allow a reasonable period of time to complete any item of assessment if you manage your time effectively. Late submissions will incur a penalty unless there are extenuating circumstances (e.g. medical) supported by appropriate documentation. Penalties are as follows:

- For assessments submitted up to two working days after the deadline, the full allocated mark will be reduced by 10 percentage marks (but no lower than the pass mark).
- For assessments submitted more than two working days and up to five working days after the deadline, the full allocated mark will be reduced to the minimum pass mark (providing the work is of pass standard).
- For assessments submitted more than five working days after the deadline, but before the end of the second week in term 3, a mark of zero will be recorded. However, the assessment will be considered complete.

**Word counts**

Some assessments (usually involving the production of reports) carry specified minimum and/or maximum word counts. Where a word count is included, the rubric will provide clear details of any penalties that will apply for over- or under-writing. Word count penalties will not exceed a 10 percentage point deduction in marks and will not take a student’s mark below the pass mark. In the case of coursework that is submitted late and is also under- or over-length, the greater of any penalties will apply.

The word count will be considered to include all text and formulae in the abstract and main body of the assessment (including figure and table captions), but to exclude the table of contents, reference lists and 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.

**Use of calculators in examinations**

Students are expected to bring a calculator with them to examinations for Statistical Science courses. 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. With the exception of STAT6101 and STAT6102, no other type of calculator is permitted for use in examinations for the courses described in this document. Students are therefore strongly advised to purchase one of these calculators as soon as possible. For courses STAT6101 and STAT6102, the course lecturer will tell you at the outset which calculator models are permitted. The use of a non-approved calculator constitutes an examination irregularity (i.e. cheating) and carries potentially severe penalties.

**Course details**

The following pages give more detail, including outline syllabuses, of the courses previously referred to in this document. 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.
Service courses

STAT6101
INTRODUCTORY STATISTICAL METHODS AND COMPUTING (0.5 UNIT)

Level: First

Aims of course: To provide an introduction to statistical methods and interpretation of data, along with associated computing. To provide some expertise in applying quantitative methods in the Life and Physical Sciences. The statistical methods covered are useful in the routine analysis of scientific methods, as might be encountered in other course units.

Objectives of course: On completion of the course a student should have an understanding of basic methods of descriptive statistics, confidence intervals and significance tests, which they could apply to simple standard situations in their own field of study.

Prerequisites: GCSE Mathematics, or equivalent.


Texts: A set of lecture slides together with additional pre- and post-workshop reading material is provided via Moodle. For supplementary reading, students may wish to consult:


or have a further look at:


Assessment for examination grading: In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. Students are allowed to take into the examination their course notes and workshop exercises. The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Workshops: These are supervised classes in which the students apply statistical methods to data from the Life and Physical Sciences. Some workshops require the use of the Microsoft Excel software. Students’ progress during them will be continually monitored.

Timetable: There are no formal lectures for this course; all classes are workshops, at which attendance is compulsory. Workshops are held twice-weekly and each workshop is a 2 hour session

Computer registration: All students attending STAT6101 must register to use the College computing service before the first workshop.

STAT6102
INTRODUCTORY STATISTICAL METHODS (A) (0.5 UNIT)

Level: First

Aims of course: To provide an introduction to statistical methods and interpretation of data, along with associated computing required by managers. This course is intended to be taken by students registered for the School of Slavonic and East European Studies’ “Economics and Business” degree programmes, as well as students registered for single- and joint-honours degree programmes involving Management Science (e.g. BSc Information Management for Business, BA Language with / and Management Studies). Students from other departments wishing to take an introductory statistics module should normally register for STAT6101 instead.
Objectives of course: On completion of the course a student should have an understanding of basic methods of descriptive statistics, confidence intervals and significance tests, which they could apply to simple applications in business studies, and be able to carry out using appropriate computer software.

Prerequisites: GCSE Mathematics, or equivalent.


Texts: A set of lecture slides together with additional notes for reading before and/or after certain workshops is provided via Moodle. For supplementary reading, students may wish to consult:


and for business specific reading:


together with [www.ucl.ac.uk/lynda](http://www.ucl.ac.uk/lynda) for Excel tutorials.

Assessment for examination grading: In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. Students are allowed to take into the examination their course notes and workshop exercises. The final mark is a 4 to 1 weighted average of the written examination and in-course assessment marks.

Workshops: These are supervised classes in which the students apply statistical methods to business data. Some workshops require the use of the Microsoft Excel software. Students' progress during the workshops will be continually monitored.

Timetable: There are no formal lectures for this course; all classes are workshops at which attendance is compulsory. Workshops are held weekly and each workshop is a 2 hour session.

Computer registration: All students attending STAT6102 must register to use the College computing service before the first workshop.

STAT7101 FURTHER STATISTICAL METHODS AND COMPUTING (0.5 UNIT)

The content and delivery of this course is the same as for STAT2002 (see under Departmental Courses below). The only differences are that a tutorial class is scheduled for STAT7101 students, who also receive a separate examination paper (and are allowed to take into the examination their course notes and tutorial exercises). This is to allow the course to be taken by students with less strong mathematical backgrounds. The prerequisite is a strong performance (normally, a final mark of at least 70%) in STAT6101 or equivalent.

**Departmental courses**

STAT1004 INTRODUCTION TO PROBABILITY & STATISTICS (0.5 UNIT)

Level: First

Aims of course: To provide an accessible and application-oriented introduction to basic ideas in probability and statistics. Together with STAT1005 and STAT1006, this provides the foundation for further study of statistics in the degree programmes offered by the Department of Statistical Science or jointly with other Departments. It may also serve as a foundation course for students taking a Statistics stream as part of a Natural Sciences degree.

Objectives of course: On successful completion of the course, a student should understand, at an intuitive level, the basic concepts in probability theory; be able to use
fundamental laws of probability to solve simple problems; recognise simple situations in which standard univariate probability distributions may be useful, and apply results for these distributions as appropriate in these situations; be able to choose and apply appropriate simple techniques for the presentation and description of data; understand the concepts of a probability model and sampling variability; and be aware of the need to check assumptions made when using a given probability model.

Applications: This course motivates the use of probability and statistics in a wide range of application areas. Recent high-profile statistical applications in areas such as politics, road safety, space travel, public health and criminal justice are discussed. Smaller teaching examples come from astronomy, medicine, meteorology, education, genetics, finance and physics.

Prerequisites: Grade A in A level Mathematics, or equivalent.


Assessment for examination grading:
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2 ½ hour written examination in term 3. The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

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

Timetabled workload:
Lectures: 3 hours per week. Tutorials: 1 hour per week.

STAT1005 FURTHER PROBABILITY AND STATISTICS (0.5 UNIT)

Level: First

Aims of course: To introduce a formal framework for the study of probability and statistics, building on the intuitive concepts introduced in STAT1004. Together with STAT1004 and STAT1006, this provides the foundation for further study of statistics in the degree programmes offered by the Department of Statistical Science or jointly with other Departments. It may also serve as a core course for students taking a Statistics stream as part of a Natural Sciences degree.

Objectives of course: On successful completion of the course, a student should be able to derive simple results in probability using an axiomatic approach; know how to derive properties of discrete and continuous univariate probability distributions; be able to give an informal statement of the Central Limit Theorem for independent identically distributed random variables; be able to calculate confidence intervals and carry out hypothesis tests in simple situations; be able to run a simple linear regression and interpret the results.


Texts:
Applications: Probability and statistics have applications in almost every field of quantitative investigation; this course introduces techniques that are applicable in a variety of simplified real-life situations, and provides the foundations for the advanced methods required in more complex problems.

Prerequisites: Grade A in A level Mathematics, or equivalent, and prior or simultaneous attendance on STAT1004.

Course content: Axioms of probability, conditional probability, combinatorics. Discrete and continuous random variables: probability mass functions, probability density functions, distribution functions, expectation and variance, revision of necessary integration techniques, moment generating functions. Further distributions (negative binomial, hypergeometric, gamma). Transformations of random variables, idea of Central Limit Theorem. Introduction to point estimation methods. Definitions, properties and use of chi-squared, t and F distributions. Sampling distributions, standard errors, confidence intervals and significance. Methods applicable to binomial, Poisson and normally distributed data for one and two sample problems. Inference in the simple linear regression model.

Texts:

Assessment for examination grading:
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

Other set work:
Weekly exercises and/or practical assignments. These will not count towards the examination grading.

Timetabled workload:
Lectures: 3 hours per week.
Tutorials: 1 hour per week.

STAT2002
LINEAR MODELS AND THE ANALYSIS OF VARIANCE (0.5 UNIT)

Level: Intermediate

Aims of course: To provide an introduction to linear statistical modelling and to the analysis of variance with emphasis on ideas, methods, applications and interpretation of results.

Objectives of course: On successful completion of the course, a student should have an understanding of the basic ideas underlying multiple regression and the analysis of variance; be able to analyse, using a statistical package, data from some common experimental layouts and carry out and interpret simple and multiple regression analyses; understand the assumptions underlying these analyses and know how to check their validity.

Applications: Linear models and the analysis of variance (ANOVA) are two basic and powerful statistical tools to model and analyse the relationship between random variables, and thus are widely used in almost all of classical and modern statistical practice. Their use exemplifies the modern, model-based approach to statistical investigations, and provides the foundations for more advanced techniques that may be required for the study of complex systems arising in areas such as economics, natural and social sciences and engineering as well as in business and industry.

Prerequisites: STAT1004 and STAT1005, or equivalent (e.g. ECON2007).

Course content: Analysis of variance for a variety of experimental designs. Multiple regression: model fitting by least squares, model assessment and selection. Heteroscedastic and autocorrelated errors. Emphasis will be placed on ideas, methods, practical applications, interpretation of results and computer output, rather than on detailed theory.
Texts:

Assessment for examination grading:
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. 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 practical exercises. These will not count towards the examination grading.

Timetabled workload:
Lectures: 3 hours per week, 1 hour of which to be used as necessary as a problems class.

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**STAT7002**
**SOCIAL STATISTICS (0.5 UNIT)**

**Level**: Intermediate

**Aims of course**: To provide an introduction to the basic mathematical aspects of sample survey design and statistical analysis, to the practical aspects involved in carrying out a survey and to some key concepts in measurement theory.

**Objectives of course**: On successful completion of the course, a student should have an understanding of the basic principles and methods underlying sample surveys, be able to assess the appropriateness of various sampling schemes and to calculate precisions and sample sizes required to achieve specific precisions or costs, to have a basic understanding of the ideas underlying the scale type classification and the concepts of validity and reliability, to construct and evaluate a Likert scale and to have a general knowledge of practical survey methods and statistics in society.

**Applications**: Areas of application of the methods taught in this course include governmental statistics, public health research, opinion polls, market research, and customer relationship management. Sampling techniques are also used, for example, in industrial quality control.

**Prerequisites**: STAT2001 or equivalent (e.g. ECON2007).

**Course content**: Introduction to sampling, simple random sampling. Sources of error, practical survey methods. Planning a survey, questionnaire construction (with some philosophical background) and data collection techniques. Scale types, Likert scales, validity and reliability. Basic ideas of stratified, cluster and systematic sampling and ratio estimation. Analysis of Social Statistics.

**Texts**:
Central Statistical Office: *Social Trends*.

**Assessment for examination grading**: In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. 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. Problem classes: arranged as necessary.

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**STAT7003**
**OPTIMISATION ALGORITHMS IN OPERATIONAL RESEARCH (0.5 UNIT)**

**Level**: Advanced

**Aims of course**: To provide an introduction to the ideas underlying the optimal choice of component variables, possibly subject to constraints, that maximise (or minimise) an objective function. The algorithms described
are both mathematically interesting and applicable to a wide variety of complex real life situations.

**Objectives of course:** On successful completion of the course, a student should be able to understand the theoretical concepts of linear programming, dynamic programming and finite Markov programming, set up correct models of real life problems, interpret results correctly and check the validity of assumptions.

**Applications:** Optimisation methods provide the means for successful business strategies, scientific planning and statistical estimation under constraints. They are a critical component of any area where decision making under limited resources is necessary.

**Prerequisites:** Mathematics course beyond A level and an introduction to probability.


**Texts:**

**Assessment for examination grading:**
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. The final mark is a 9 to 1 weighted average of the written examination and in-course assessment marks.

**Other set work:**
About 6 sets of exercises. These will not count towards the examination grading.

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**Timetabled workload:**
Lectures and problems classes: 3 hours per week.

**STAT3003 FORECASTING (0.5 UNIT)**

**Level:** Advanced

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

**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:** STAT2001 and STAT2002, or equivalent (e.g. ECON2007).


**Texts:**
STAT3004

DECISION AND RISK (0.5 UNIT)

Level: Advanced

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: STAT1004 and STAT1005, or equivalent (e.g. ECON2007).

Course content

Assessment for examination grading
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. 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.

STAT3006

STOCHASTIC METHODS IN FINANCE (0.5 UNIT)

Level: Advanced

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: STAT2001 or equivalent (e.g. ECON2007).


Assessment for examination grading: In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. 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: 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.

STAT3022 QUANTITATIVE MODELLING OF OPERATIONAL RISK AND INSURANCE ANALYTICS (0.5 UNIT)

Level: Advanced

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;
- describe 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 calculation;
- 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 STAT2001, ECON2007 or equivalent. Also some basic experience in either Matlab, Python or R is needed, as
taught in STAT7001 or equivalent.


**Texts:**


**Assessment for examination grading:**
In-course assessment (see page 4), the exact method of which will be announced by the lecturer at the beginning of the course. 2½ hour written examination in term 3. 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.

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 2016.