Courses in Statistical Science for Undergraduates on Affiliate Programmes (Autumn Term Only)

2014/15
Who should use this document?

This document provides a guide to courses offered by the Department of Statistical Science for undergraduate affiliate students who are enrolled at UCL during the autumn term only (i.e. from September to December). This includes affiliate students registered in the Department of Statistical Science and also those registered in other UCL departments who wish to take a course in Statistics as an optional module.

This document is not relevant for undergraduate affiliate students who are enrolled at UCL for the full academic year, or during the spring and summer terms only. The arrangements for these students are the same as for regular UCL undergraduates:

- Students on Statistical Science degree programmes should refer to the undergraduate student handbook.
- Students on Mathematics degree programmes should refer to the separate handbook: Courses in Statistical Science for Mathematics Undergraduates.
- Students on all other degree programmes should refer to the separate handbook: Courses in Statistical Science for Undergraduates on Other Degree Programmes.

Courses available

Any of the Department’s undergraduate courses for which all the study elements (lectures, tutorials, etc.) take place entirely during the autumn term are available. The affiliate versions of these courses have identical teaching arrangements to the versions for regular UCL undergraduates, but alternative examination arrangements. To reflect the different pattern of assessment, the module codes for the affiliate courses are distinguished by the addition of an “A” suffix. Much of the course literature (lecture notes, Moodle posts etc.) may not explicitly reference the affiliate module code, however, unless otherwise stated, the content should be assumed to be equally relevant to both cohorts of students.

The courses described below fall into two categories:

- **Service courses** specially provided for students from other departments
- **Departmental courses** offered to Statistical Science undergraduates that may also be suitable for students from other departments.

### Service Courses

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<thead>
<tr>
<th>Course Title</th>
<th>Code</th>
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<tr>
<td>Introductory Statistical Methods &amp; Computing</td>
<td>STAT6101A</td>
<td>First</td>
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<tr>
<td>Further Statistical Methods &amp; Computing²</td>
<td>STAT7101A</td>
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<tr>
<td>Probability and Statistics II³</td>
<td>STAT3101A</td>
<td>Advanced</td>
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### Departmental Courses

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<tr>
<th>Course Title</th>
<th>Code</th>
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<tbody>
<tr>
<td>Introduction to Probability &amp; Statistics</td>
<td>STAT1004A</td>
<td>First</td>
</tr>
<tr>
<td>Probability and Inference³</td>
<td>STAT2001A</td>
<td>Intermediate</td>
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1 Affiliate students, sometimes also referred to as Study Abroad or Exchange students, are students registered at other higher education institutions who have enrolled to UCL to gain credit for courses taken here before returning to their home universities in order to graduate.

2 STAT7101A may not be taken by students from the Mathematics or Economics departments. Students from these departments should register for course STAT2002A instead.

3 Students may not take both STAT2001A and STAT3101A.
The courses are all 0.5 units. Syllabuses are given at the end of the document.

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 below are in this location.

For general advice and information about statistics courses and BEFORE registering for a course on Portico, affiliate students MUST consult a member of the Statistical Science staff, who will determine whether they have the necessary academic prerequisites.

Affiliates registered in the Department of Statistical Science

These students should discuss their module selections with the Statistical Science Tutor for Affiliates, Dr Serge Guillas (s.guillas@ucl.ac.uk).

Affiliates registered in other UCL departments

These students should attend one of the following registration sessions:

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

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<thead>
<tr>
<th>Date</th>
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<th>Staff Member</th>
<th>Room</th>
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<tbody>
<tr>
<td>Monday 22 September</td>
<td>13:00 – 15:30</td>
<td>Dr Giampiero Marra</td>
<td>142</td>
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<tr>
<td>Tuesday 23 September</td>
<td>13:00 – 15:30</td>
<td>Dr Giampiero Marra</td>
<td>142</td>
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<tr>
<td>Wednesday 24 September</td>
<td>13:00 – 15:30</td>
<td>Dr Giampiero Marra</td>
<td>142</td>
</tr>
<tr>
<td>Thursday 25 September</td>
<td>14:00 – 17:00</td>
<td>Dr Ricardo Silva</td>
<td>139</td>
</tr>
<tr>
<td>Friday 26 September</td>
<td>14:00 – 17:00</td>
<td>Dr Ricardo Silva</td>
<td>139</td>
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- **After the first week of term 1**, see Dr Ricardo Silva (room 139) during his regular office hours (Mondays 11:00-12:00, Wednesdays 12:00-13:00 and Fridays 14:00-15:00).

To formally register after these discussions, use the Portico system. Ensure that any course codes you select have an "A" suffix, as 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.

Teaching arrangements

The 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.

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4 Students with non-mathematical backgrounds should register for STAT7101A rather than STAT2002A.
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.**

Timetable

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.
- 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 oral examination. The final mark is obtained by combining the in-course assessment mark and the oral 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 at any level below Masters, a final mark of at least 40% is required. To pass a Masters-level course, a final mark of at least 50% 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.

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 work submitted after the deadline but before the end of the next working day, the full allocated mark will be reduced by 5 percentage marks.
- For work submitted at any time during the following six days, the mark will be reduced by a further 10 percentage marks.
- For assessments submitted more than 7 days late 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 a specified maximum word count. Assessed work should not exceed the prescribed length. If submitted work is found to exceed the upper word limit by less than 10%, the mark will be reduced by ten percentage marks, subject to a minimum mark of 40% (50% for fourth year courses) providing the work is of pass standard. For work that exceeds the upper word limit by 10% or more, a mark of zero will be recorded. In the case of coursework that is submitted late and is also over length, the lateness penalty will have precedence.

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 STAT6101A, 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 course STAT6101A, 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.

**Oral examinations**

Oral examinations take place in the last week of the autumn term (and substitute for the written examinations taken by regular UCL undergraduates in the summer). Students will be contacted individually with details of the date and time, venue etc.

**Who will be present**: only a single student will be present and examined at any one time. There will be two internal examiners present at each oral exam, the first of which will usually be the course lecturer. The external examiner will be invited, but is not required to attend.

**Preparation**: some information about the exam format is given below, but the first examiner will give the student more detailed information at least ten days in advance, particularly about any specific material that needs to be prepared.

**What should you take to the exam**: bring an approved means of identification according to the current UCL examinations guide (e.g. a UCL ID card, passport or driving licence with photograph). This is all that is needed, unless the first examiner specifies something more.
Who will ask the questions: the two internal examiners can both ask questions. The first examiner will normally take the lead in questioning.

Length of the exam: the length of the oral exam should be at least 30 minutes and no more than 45 minutes.

What can be asked: there are various methods to carry out an oral exam. Some approaches are:

- asking for (more or less) detailed solutions to some of the work previously set as unassessed coursework exercises earlier in the course;
- asking a student to prepare a small presentation in advance about a certain part of the syllabus, such as a chapter of the course notes, giving an overview and presenting an easy example. It is possible to ask the student for topic suggestions. This could take 10 minutes, followed by questions of a different nature, see below;
- asking for key definitions and concepts together with some small practical tasks (such as interpreting a computer output, straightforward arithmetic tasks if required in the syllabus, giving an overview of an algorithm etc.).

A certain portion of the exam time can be used for discussing with the student in detail how the student responded to some earlier questions, thus checking how deep the student’s understanding goes. This means that the examiners cannot be expected to agree all questions in advance and to stick to such a pre-defined protocol.

Some (and in many exams most) questions asked will require the student to write something down (paper and a pen or pencil will be provided by the examiners if needed).

The first examiner will inform the student in advance which approach will be used.

Taking notes: one of the examiners will take notes of what was asked, and the final result.

Communicating the result: students should be informed of their provisional grade by the first examiner within one week of the exam.

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

STAT6101A
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.

Normal prerequisites for guidance: GSCE Mathematics, or equivalent.

Texts: A set of course notes is provided via Moodle. For supplementary reading, students may wish to consult:


Assessment for examination grading: In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral 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 MINITAB computer package. 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.

STAT7101A
FURTHER STATISTICAL METHODS AND COMPUTING (0.5 UNIT)

The content and delivery of this course is the same as for STAT2002A (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 usual prerequisite is a strong performance (normally, a final mark of at least 70%) in STAT6101 or equivalent.

STAT3101A
PROBABILITY AND STATISTICS II (0.5 UNIT)

Level: Advanced

Aims of course: This course continues the study of probability and statistics beyond the basic concepts introduced in Probability and Statistics I (MATH7501). It aims to provide further study of probability theory, in particular...
as it relates to multivariate random variables, and it introduces formal concepts and methods in statistical estimation.

Objectives of course: On successful completion of the course, a student should have an understanding of the properties of joint distributions of random variables and be able to derive these properties and manipulate them in straightforward situations; recognise the $\chi^2$, $t$ and $F$ distributions of statistics defined in terms of normal variables; be able to apply the ideas of statistical theory to determine estimators and their properties satisfying a range of estimation criteria.

Applications: As with other core modules in probability and statistics, the material in this course has applications in almost every field of quantitative investigation; the course introduces general-purpose techniques that are applicable in principle to a wide range of real-life situations.

Normal prerequisites for guidance: MATH7501 or equivalent.

Course content: Joint probability distributions: joint and conditional distributions and moments; serial expectation; multinomial and multivariate normal distributions. Transformation of random variables: distributions; approximation of moments; order statistics. Moment and probability generating functions: properties; sums of independent random variables; Central Limit Theorem. Relations between standard distributions: $\chi^2$, $t$ and $F$ distributions; orthogonal transformation of multivariate normal distribution; Poisson-multinomial connections. Statistical estimation: bias, mean square error, consistency, best linear unbiased estimators; method of moments, least squares, maximum likelihood, Cramér-Rao lower bound. Simple examples will be used throughout to motivate and illustrate the topics discussed.

Texts:


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

Other set work:
About 2 sets of exercises. These will not count towards the examination grading.

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

Departmental courses

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**STAT1004A**

**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.

Normal prerequisites for guidance: Grade A in GCE A Level Mathematics, or equivalent.


Texts:

Assessment for examination grading: In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral 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.

STAT2001A
PROBABILITY AND INFERENCE (0.5 UNIT)

Level: Intermediate

Aims of course: To continue the study of probability and statistics beyond the basic concepts introduced in STAT1004 and STAT1005. To provide further study of probability theory, in particular as it relates to multivariate random variables, and to introduce formal concepts and methods in statistical estimation.

Objectives of course: on successful completion of the course, a student should have an understanding of the properties of joint distributions of random variables and be able to derive these properties and manipulate them in straightforward situations; recognise the $\chi^2$, t and F distributions of statistics defined in terms of normal variables; be able to apply the ideas of statistical theory to determine estimators and their properties satisfying a range of estimation criteria.

Applications: As with other core modules in probability and statistics, the material in this course has applications in almost every field of quantitative investigation; the course introduces general-purpose techniques that are applicable in principle to a wide range of real-life situations.
Normal prerequisites for guidance: STAT1004 and STAT1005 or their equivalents. MATH6401 and MATH6402 or their equivalents.

Course content: Simple examples will be used throughout to motivate and illustrate the topics discussed. Joint probability distributions; joint and conditional distributions and moments; serial expectation; multinomial and multivariate normal distributions. Transformation of random variables: distributions; approximation of moments; order statistics. Moment and probability generating functions: properties; sums of independent random variables; Central Limit Theorem. Relations between standard distributions: \( \chi^2, t \) and \( F \) distributions; orthogonal transformation of multivariate normal distribution; Poisson-multinomial connections. Statistical estimation: bias, mean square error, consistency, best linear unbiased estimators; method of moments, least squares, maximum likelihood, Cramér-Rao lower bound.

Texts:

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

Other set work:
About 2 sets of exercises. These will not count towards the examination grading.

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

STAT2002A
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.

Normal prerequisites for guidance: STAT1004 and STAT1005, or their equivalents.

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 3), the exact method of which will be announced by the lecturer at the beginning of the course.
Oral examination at the end of term.
The final mark is a 9 to 1 weighted average of the oral 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.

STAT7003A
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.

Normal prerequisites for guidance: STAT1004 or its equivalent.


Texts:

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

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

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

STAT3001A
STATISTICAL INFERENCE (0.5 UNIT)

Level: Advanced

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, and to provide theory underlying the methods taught in the first and second years of degree courses offered by the Department of Statistical Science or jointly with other Departments.
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.

Normal prerequisites for guidance: STAT2001 and STAT2002, or their equivalents.


Assessment for examination grading: In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral 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.
Tutorials: 1 hour per week.

STAT3002A
STOCHASTIC SYSTEMS (0.5 UNIT)

Level: Advanced

Aims of course: To provide a continuation of the study of random processes started in Introduction to Applied Probability (STAT2003), but with the emphasis now 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).

**Normal prerequisites for guidance:**
STAT2003 or its equivalent.

**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:**

**Assessment for examination grading:**
In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral 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.
Tutorials: 1 hour per week.

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**STAT3006A**

**STOCHASTIC METHODS IN FINANCE I**

(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.

**Normal prerequisites for guidance:**
STAT2001 or its equivalent.


**Texts:**

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

STAT3008A
MEDICAL STATISTICS I (0.5 UNIT)

Level: Advanced

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 types of observational studies and their design issues, the different measures of health outcome, and design features of randomised trials; be able to implement and interpret results from basic methods of analysis used in health studies as well as, logistic regression and basic methods of survival analysis.

Applications: This course, together with STAT3009, has applications in both medicine and epidemiology. Important areas include the design and analysis of medical research studies, including randomised controlled trials.

Normal prerequisites for guidance:
STAT2002 or its equivalent. Simultaneous or previous attendance on STAT3001.


There will be computer or paper based practical sessions on study design, measures of health outcome, confounding and interaction, logistic regression, analysis of trials and sample size calculation, survival analysis and critical appraisal.

Texts:

Assessment for examination grading:
In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral examination and in-course assessment marks.
Other set work:
Several sets of exercises. 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.

STATM001A
STATISTICAL MODELS AND DATA ANALYSIS (0.5 UNIT)

Level: Masters

Aims of course: To introduce the theory of linear and generalised linear 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 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 STATM001 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.

Normal prerequisites for guidance:
STAT2001 and STAT2002. Simultaneous or previous attendance on STATM012 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. (Students are expected to obtain the computing skills to implement the methodology discussed in this course in the course STATM003.)

Texts:

Assessment for examination grading:
In-course assessment (see page 3), the exact method of which will be announced by the lecturer at the beginning of the course. Oral examination at the end of term. The final mark is a 9 to 1 weighted average of the oral 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: 3 hours per week.
Tutorials: 1 hour per week.

STATM002A
STATISTICAL DESIGN OF INVESTIGATIONS (0.5 UNIT)

Level: Masters

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.


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:

Assessment for examination grading: Oral examination at the end of term (100%).

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.

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 2014.