Modules in Statistical Science for Undergraduates on Other Degree Programmes

2019/20
Who should use this document?

This document provides a guide to the modules offered by the Department of Statistical Science that are available to undergraduates registered in other UCL departments. However, it is NOT intended for use by the following groups of students:

- Students registered on Mathematics degree programmes. A separate handbook: Modules in Statistical Science for Mathematics Undergraduates is provided for these students.
- Students registered on the Mathematics and Statistics stream of the BSc / MSci Natural Sciences degree programmes, for whom separate arrangements are made (details are available from the Faculty of Mathematical and Physical Sciences).
- 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 the BSc / MEng Computer Science degree programmes, for whom separate arrangements are made (details are available from the Department of Computer Science).
- Students registered for the second year of the BSc / MSci Applied Medical Sciences and BSc Nutrition and Medical Sciences degree programmes, for whom separate arrangements are made (details are available from the Division of Medicine).
- Students registered on undergraduate affiliate programmes who are enrolled at UCL during the autumn term only. None of the modules offered by the Department of Statistical Science are suitable for these students (because the final examinations do not take place until the summer term).

Modules Available

The modules described below fall into two categories:

- Service modules specifically provided for students from other departments;
- Departmental modules primarily intended for Statistical Science undergraduates, but which are also suitable for students from other departments.

Syllabuses for all modules are given at the end of the document. The modules are all 15 credits. In most cases, prerequisites equivalent to those stated are acceptable.

Service Modules

<table>
<thead>
<tr>
<th>Year</th>
<th>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 and Computing</td>
<td>STAT0021</td>
<td>4</td>
<td>1 or 2</td>
<td>GCSE Maths</td>
</tr>
<tr>
<td>1</td>
<td>Introductory Statistical Methods</td>
<td>STAT0022</td>
<td>4</td>
<td>1 &amp; 2</td>
<td>GCSE Maths</td>
</tr>
</tbody>
</table>

Departmental Modules

<table>
<thead>
<tr>
<th>Year</th>
<th>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 and Statistics</td>
<td>STAT0002</td>
<td>4</td>
<td>1</td>
<td>A-level Maths (grade A)</td>
</tr>
<tr>
<td>1 or 2</td>
<td>Further Probability and Statistics</td>
<td>STAT0003</td>
<td>4</td>
<td>2</td>
<td>STAT0002</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Linear Models and the Analysis of Variance</td>
<td>STAT0006</td>
<td>5</td>
<td>1</td>
<td>STAT0003, STAT0003, STAT0021, or ECON0019</td>
</tr>
<tr>
<td>Year</td>
<td>Title</td>
<td>Code</td>
<td>Level</td>
<td>Term</td>
<td>Prerequisite</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------</td>
<td>---------</td>
<td>-------</td>
<td>------</td>
<td>----------------------</td>
</tr>
<tr>
<td>2 or 3</td>
<td>Social Statistics</td>
<td>STAT0024</td>
<td>5</td>
<td>2</td>
<td>ECON0019</td>
</tr>
<tr>
<td>3</td>
<td>Forecasting</td>
<td>STAT0010</td>
<td>6</td>
<td>2</td>
<td>ECON0019</td>
</tr>
<tr>
<td>3</td>
<td>Decision and Risk</td>
<td>STAT0011</td>
<td>6</td>
<td>2</td>
<td>STAT0003 or ECON0019</td>
</tr>
<tr>
<td>3</td>
<td>Stochastic Methods in Finance</td>
<td>STAT0013</td>
<td>6</td>
<td>1</td>
<td>ECON0019</td>
</tr>
<tr>
<td>3</td>
<td>Quantitative Modelling of Operational Risk and Insurance Analytics</td>
<td>STAT0020</td>
<td>6</td>
<td>2</td>
<td>ECON0019</td>
</tr>
<tr>
<td>3</td>
<td>Optimisation Algorithms in Operational Research</td>
<td>STAT0025</td>
<td>6</td>
<td>1</td>
<td>STAT0021 or STAT0022</td>
</tr>
</tbody>
</table>

**Advice and registration**

The Department of Statistical Science is situated on the first and second floors of 1-19 Torrington Place. The room numbers of the staff listed below refer to this location.

**STAT0021**

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 until the module is at capacity.

**STAT0022**

Any student on a BA “Language with/ and Management” degree with GCSE Mathematics or equivalent may register for this module on Portico. All such registrations will be approved automatically by the Statistical Science Department until the module is at capacity. Students on other degree programmes should **NOT** opt for this module without consulting a member of staff in the Department of Statistical Science (see below): in general they should opt for STAT0021 instead.

Prospective students should be aware that STAT0022 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 module is designed to be accessible to students without A level Mathematics, but such students may find the material 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 STAT0022, 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 module should discuss the matter in the first instance with their programme tutor in their home department.

**All other modules**

With the exception of STAT0021 and STAT0022, students **MUST** consult a member of staff in the Department of Statistical Science, who will determine whether they have the necessary academic prerequisites. Daily registration sessions will be held according to the below schedule throughout the first two weeks of term 1, which students must attend in person (staff will **NOT** be available to discuss module selections outside of term time). These sessions can also be utilised to obtain general advice and information about the suitability of Statistical Science modules, including STAT0021.

---

1. Besides ECON0019 (or equivalent), some basic experience in either Matlab, Python or R is also required.
2. Besides a required module in introductory probability (e.g. STAT0021 or STAT0022), it is preferable for a student to have done some further study of Mathematics since starting their degree programme.
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Staff Member</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 23 September</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Tuesday 24 September</td>
<td>10:00 – 12:00</td>
<td>Dr Tom Honnor</td>
<td>127</td>
</tr>
<tr>
<td>Wednesday 25 September</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Thursday 26 September</td>
<td>10:00 – 12:00</td>
<td>Dr Niloufar Abourashchi</td>
<td>127</td>
</tr>
<tr>
<td>Friday 27 September</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Monday 30 September</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Tuesday 01 October</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Wednesday 02 October</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Thursday 03 October</td>
<td>11:00 – 12:30</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
<tr>
<td>Friday 04 October</td>
<td>11:00 – 13:00</td>
<td>Dr Sam Livingstone</td>
<td>128</td>
</tr>
</tbody>
</table>

After the second week of term 1, students should seek to register with Dr Sam Livingstone (samuel.livingstone@ucl.ac.uk) via email. (Students who email Dr Livingstone earlier than this will simply be directed to attend one of the daily registration sessions in person.)

*Your selection will **NOT** receive teaching department approval on Portico unless you have successfully registered with the Department according to the above procedure (or if the module has already reached capacity).*

**Teaching arrangements**

The service modules STAT0021 and STAT0022 are taught through *compulsory* workshops. STAT0022 is taught throughout terms 1 and 2. Detailed arrangements for STAT0021 are given below.

The remaining modules 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 modules; 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 module 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 module mark.**

**Timetable**

**STAT0021:** This module 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 13:00-15:00, 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 modules and subject to room size constraints. *Students must **NOT** change from their allocated group without the prior agreement of the module organiser.* Details of room locations for each group will be available from [http://www.ucl.ac.uk/timetable](http://www.ucl.ac.uk/timetable).
All other modules: Module timetables are available from http://www.ucl.ac.uk/timetable, usually from mid-August onwards. After making your module selections on Portico, tutorial allocation for Statistical Science modules will be arranged by a Teaching & Learning Administrator before lessons 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 modules start in week 2 of term 1.
- Term 2 lectures and workshops begin on the first day of term.
- Teaching for all Statistical Science modules continues until the last day of each term.

Assessment
For most modules, 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 module described later in this handbook, a guideline is given to indicate the scheme used for combining marks. To pass a module, a final mark of at least 40.00% is required.

In-course assessment
At the beginning of each module, the lecturer will provide details of the method and dates of any in-course assessment. The assessment dates will also be posted on the module 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 module. 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 Teaching & Learning Office or the module lecturer by a set deadline. For such assessments, you will need to sign a cover sheet (provided by the module 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.

Module details
The following pages give more detail, including outline syllabuses, of the modules previously referred to in this document. For most modules, some indication is also given of areas where the material may be applied in practice; this is to help students decide which modules might be most suitable for them.

3 Guidance on what constitutes plagiarism (and collusion) is also available from the Department of Statistical Science Undergraduate Student Handbook.
Service modules

STAT0021
INTRODUCTORY STATISTICAL
METHODS AND COMPUTING

Level: 4 Credits: 15 Term: 1 or 2

Aims: 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 modules.

Objectives: On completion of the module 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:
• In-course assessment (see page 5)
• 2 ½ hour written examination
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 module; 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 STAT0021 must register to use the College computing service before the first workshop.

STAT0022
INTRODUCTORY STATISTICAL
METHODS

Level: 4 Credits: 15 Term: 1 & 2

Aims: To provide an introduction to statistical methods and interpretation of data, along with associated computing required by managers. This module 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 STAT0021 instead.

Objectives: On completion of the module 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 LinkedIn Learning for Excel tutorials.

Assessment:
- In-course assessment (see page 5)
- 2 ½ hour written examination
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 module; 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 STAT0022 must register to use the College computing service before the first workshop.

Departmental modules

**STAT0002**

**INTRODUCTION TO PROBABILITY AND STATISTICS**

**Level:** 4  **Credits:** 15  **Term:** 1

Aims: To provide an accessible and application-oriented introduction to basic ideas in probability and statistics. Together with STAT0003 and STAT0004, 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 module for students taking a Statistics stream as part of a Natural Sciences degree.

Objectives: On successful completion of the module, 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 module 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.


**Texts:**

**Assessment:**
- In-course assessment (see page 5)
- 2 1/2 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:**
Weekly sets of exercises. These will not count towards the final mark.

**Timetabled workload:**
- Lectures: 3 hours per week.
- Tutorials: 1 hour per week.
applicable to binomial, Poisson and normally distributed data for one and two sample problems. Inference in the simple linear regression model.

**Texts:**

**Assessment:**
- In-course assessment (see page 5)
- 2 ½ 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:**
Weekly exercises and/or practical assignments. These will not count towards the final mark.

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

---

**STAT0006 LINEAR MODELS AND THE ANALYSIS OF VARIANCE**

**Level:** 5  
**Credits:** 15  
**Term:** 1

**Aims:** 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:** On successful completion of the module, 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:** STAT0002 and STAT0003, or equivalent (e.g. ECON0019).

**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:**
- In-course assessment (see page 3)
- Two data analysis tasks
There is no written examination. The final mark is a 3 to 1 weighted average of the data analysis tasks and in-course assessment marks.

**Other set work:**
About 8 sets of practical exercises. These will not count towards the final mark.

**Timetabled workload:**
Lectures: 3 hours per week, to be used as workshops and computer practical sessions as necessary.
STAT0024
SOCIAL STATISTICS

Level: 5 Credits: 15 Term: 2

Aims: 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: On successful completion of the module, 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 module 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: ECON0019 or equivalent.

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. Analysis of Social Statistics.

Texts:
- Central Statistical Office: Social Trends.

Assessment:
- In-course assessment (see page 5)
- 2 ½ 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 9 sets of exercises. These will not count towards the final mark.

Timetabled workload:
Lectures: 2 hours per week.
Problem classes: 1 hour per week.

STAT0010
FORECASTING

Level: 6 Credits: 15 Term: 2

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

Objectives: On successful completion of the module, 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: ECON0019 or equivalent.

Content: Forecasting as the discovery and extrapolation of patterns in time ordered data. Revision of descriptive measures for multivariate distributions. Descriptive techniques for time series. Models for stationary processes: derivation of properties.

**Texts:**

**Assessment:**
- In-course assessment (see page 5)
- 2 ½ 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 final mark.

**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 module, will also be provided.

---

### STAT0011 DECISION AND RISK

**Level:** 6  
**Credits:** 15  
**Term:** 2

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

**Objectives:** On successful completion of the module, 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 module 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 module will use examples from natural hazards, environmental hazards, finance, and social policy.

**Prerequisites:** STAT0002 and STAT0003, or equivalent (e.g. ECON0019).

**Content**

**Texts**

**Assessment:**
- In-course assessment (see page 5)
- 2 ½ 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 final mark.

**Timetabled workload:**
Lectures: 2 hours per week.
Workshops: three 1 hour classes.
Office hours, during which the lecturer will be available to discuss students’ individual problems with the module, will also be provided.

---

### STAT0013 STOCHASTIC METHODS IN FINANCE

**Level:** 6  
**Credits:** 15  
**Term:** 1

**Aims:** 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:** On successful completion of the module, 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 module 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:** ECON0019 or equivalent.


**Texts:**

**Assessment:**
- In-course assessment (see page 5)
- 2 ½ 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 final mark.

**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 module, will also be provided.

---

**STAT0020 QUANTITATIVE MODELLING OF OPERATIONAL RISK AND INSURANCE ANALYTICS**

**Level:** 6  
**Credits:** 15  
**Term:** 2

**Aims:** 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 accord. 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:** On successful completion of the module, 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 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 module 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 ECON0019 or equivalent. Also some basic experience in either Matlab, Python or R is needed.


**Assessment:**
- In-course assessment (see page 5)
- 2½ 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 final mark.

**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 module, will also be provided.

**STAT0025**
**OPTIMISATION ALGORITHMS IN OPERATIONAL RESEARCH**

**Level:** 6  
**Credits:** 15  
**Term:** 1

**Aims:** 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:** On successful completion of the module, 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 module beyond A level and an introduction to probability.


Texts:

Assessment:
• In-course assessment (see page 5)
• 2 ½ 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 6 sets of exercises. These will not count towards the final mark.

Timetabled workload:
Lectures and problems classes: 3 hours 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.

UCL Department of Statistical Science, September 2019.