1. **Title of the module**

MAST6009 (MA6510) - Advances in Statistics

MAST7009 (MA7510) – Advances in Statistics

1. **School or partner institution which will be responsible for management of the module**

School of Mathematics, Statistics and Actuarial Science

1. **The level of the module (e.g. Level 4, Level 5, Level 6 or Level 7)**

MAST6010: Level 6; MAST7009: Level 7

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Spring

1. **Prerequisite and co-requisite modules**

**Level 6:**

Pre-requisite: MAST4009 (Probability); MAST4011 (Statistics); MA5007 (Mathematical Statistics) or MAST5001 (Applied Statistical Modelling 1)

Co-requisite: None

**Level 7:**

Pre-requisite: Students are expected to have studied material equivalent to that covered in the modules above.

Co-requisite: None

1. **The programmes of study to which the module contributes**

For the level 6 module, BSc Mathematics and Statistics (including programme with a Year in Industry).

For the level 7 module, MSc Statistics, MSc Statistics with Finance, International MSc in Statistics, International MSc in Statistics with Finance (including programmes with an Industrial Placement), MMathStat Mathematics and Statistics.

1. **The intended subject specific learning outcomes**

**On successfully completing the level 6 module students will be able to:**

1. demonstrate systematic understanding of key aspects of some selected topics within modern statistics;
2. demonstrate the capability to deploy established approaches accurately to analyse and solve problems using a reasonable level of skill in calculation and manipulation in the following areas: modern statistical modelling and statistical methods;
3. apply key aspects of some selected topics within modern statistics in well-defined contexts, showing judgement in the selection and application of tools and techniques;
4. show judgement in the application of R.

**On successfully completing the level 7 module students will be able to:**

1. demonstrate systematic understanding of some selected topics within modern statistics;
2. demonstrate the capability to solve complex problems using a very good level of skill in calculation and manipulation of the material the following areas: modern statistical modelling and statistical methods;
3. apply a range of concepts and principles in some selected topics within modern statistics in loosely defined contexts, showing good judgment in the selection and application of tools and techniques;
4. make effective and well-considered use of R
5. **The intended generic learning outcomes.**

**On successfully completing the level 6 module students will be able to:**

1. manage their own learning and make use of appropriate resources;
2. understand logical arguments, identifying the assumptions made and the conclusions drawn;
3. communicate straightforward arguments and conclusions reasonably accurately and clearly;
4. manage their time and use their organisational skills to plan and implement efficient and effective modes of working;
5. solve problems relating to qualitative and quantitative information;
6. make competent use of information technology skills such as online resources (moodle), internet communication;
7. communicate technical and non-technical material competently;
8. demonstrate an increased level of skill in numeracy and computation;
9. demonstrate the acquisition of the study skills needed for continuing professional development.

**On successfully completing the level 7 module students will be able to:**

1. work competently and independently, be aware of their own strengths and understand when help is needed;
2. demonstrate a high level of capability in developing and evaluating logical arguments;
3. communicate arguments confidently with the effective and accurate conveyance of conclusions;
4. manage their time and use their organisational skills to plan and implement efficient and effective modes of working;
5. solve problems relating to qualitative and quantitative information;
6. make effective use of information technology skills such as online resources (moodle), internet communication;
7. communicate technical and non-technical material effectively;
8. demonstrate an increased level of skill in numeracy and computation;
9. demonstrate the acquisition of the study skills needed for continuing professional development.
10. **A synopsis of the curriculum**

Each year three topics will be offered and will reflect recent advances in statistical modelling and statistical methodology. Example topics are:

1. Statistical Ecology: Understanding demographic parameters and how they are used to model population dynamics. Estimating abundance and the effect of heterogeneity. Models for estimating survival probabilities. Multi-site and multi-state models. Classical model-selection. Complex models. Case studies.
2. Survival analysis: Survival data, types of censoring. Failure times and hazard functions; Accelerated failure time model. Parametric models, exponential, piecewise exponential, Weibull. Nonparametric estimates: the Kaplan-Meier estimator, and asymptotic confidence regions. Parametric inference. Survival data with covariates. Proportional hazards. Cox’s model and inference. Computer software: R and WinBUGS.
3. Regression models with many variables: Examples of high-dimensional problems; Penalized maximum likelihood; Ridge regression; non-negative garrote; Lasso and adaptive Lasso estimation; LARS algorithm; Oracle property; Elastic Net; Group lasso.
4. Modern nonparametric statistics: Bias-variance trade-off, Kernel density estimation, Kernel smoothing, Locally linear and locally quadratic estimation, basis function methods.

In addition, level 7 students will study advanced applications of these techniques (often using R) in all topics.

1. **Reading List (Indicative list, current at time of publication. Reading lists will be published annually)**

The reading list will depend on the topics offered; for the example topics the list is:

1. Statistical Ecology

McCrea, R. S. and Morgan, B. J. T. (2014): Analysis of capture-recapture data (Chapman & Hall / CRC)

1. Survival Analysis

Collet, D. (2003): Modelling survival data in medical research, Second Edition (Chapman & Hall / CRC)

1. Regression models with many variables

Hastie, T., Tibshirani, R. and Wainwright, M. J. (2015): Statistical Learning with Sparsity (Chapman & Hall / CRC).

1. Modern nonparametric statistics

 Larry Wasserman (2006): All of Nonparametric Statistics, Springer: New York.

1. **Learning and Teaching methods**

**Level 6:**

Total contact hours: 36

Private study hours: 114

Total study hours: 150

**Level 7:**

Total contact hours: 40

Private study hours: 110

Total study hours: 150

1. **Assessment methods**

13.1 Main assessment methods

**Level 6:**

Assessment 1 Exercises, requiring on average between 7 and 10 hours to complete 6.67%

Assessment 2 Exercises, requiring on average between 7 and 10 hours to complete 6.67%

Assessment 3 Exercises, requiring on average between 7 and 10 hours to complete 6.66%

At least one assessment will require the use of R.

Examination 2 hours 80%

The coursework mark alone will not be sufficient to demonstrate the student’s level of achievement on the module.

**Level 7:**

Assessment 1 Exercises, requiring on average between 7 and 10 hours to complete 6.67%

Assessment 2 Exercises, requiring on average between 7 and 10 hours to complete 6.67%

Assessment 3 Exercises, requiring on average between 7 and 10 hours to complete 6.66%

At least one assessment will require the use of R.

Examination 2 hours 80%

The coursework mark alone will not be sufficient to demonstrate the student’s level of achievement on the module.

13.2 Reassessment methods

Like-for-like

1. **Map of Module Learning Outcomes (sections 8 & 9) to Learning and Teaching Methods (section12) and methods of Assessment (section 13)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Level 6 Module learning outcome** | 8.1 | 8.2 | 8.3 | 8.4 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 | 9.9 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Private Study and Assessment | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures | **X** | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** |
| Coursework | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Level 7 Module learning outcome** | 8.5 | 8.6 | 8.7 | 8.8 | 9.10 | 9.11 | 9.12 | 9.13 | 9.14 | 9.15 | 9.16 | 9.17 | 9.18 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Private Study and Assessment | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures | **X** | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** |
| Coursework | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered:** Canterbury
2. **Internationalisation**

Statistics as a branch of mathematics is an international language with techniques developed and refined by statisticians across the globe. Mastery of the subject-specific learning outcomes, 8.1 to 8.8, will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Mathematics, Statistics and Actuarial Science, which includes many members of staff with international experience of teaching and research collaboration.

In compiling the reading list, consideration has been given to the range of texts that are available internationally and a selection of texts has been identified to complement the delivery of the material.

Examples with an international dimension are included in the module where appropriate.

The support SMSAS provides to its students is also internationally attuned given our international student body.

**DIVISIONAL OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

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| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs( Q6&7 cover sheet) |
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