1. **Title of the module**

MAST4009 (MA351) - Probability

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 (Level 4, Level 5, Level 6 or Level 7)**

Level 4

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)**

Autumn

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

Pre-requisite: An `A’ level in Mathematics or in Mathematics and Statistics or Pure Mathematics or equivalent.

Co-requisite: MAST4006: Mathematical Methods 1 or MAST4014:Calculus and Differential Equations

1. **The course(s) of study to which the module contributes**

BSc Mathematics, BSc Mathematics and Statistics, BSc Financial Mathematics, BA Mathematics, Accounting and Finance, BSc Actuarial Science, MMath Mathematics, BSc Data Science (including courses with a Year in Industry),

BSc Mathematics with Secondary Education, BSc Mathematics with a Foundation Year, BSc Actuarial Science with a Foundation Year, BSc Data Science with a Foundation Year, MMathStat Mathematics and Statistics

1. **The intended subject specific learning outcomes.  
   On successfully completing the module students will be able to:**

8.1 demonstrate knowledge of the underlying concepts and principles associated with probability;

8.2 demonstrate the capability to make sound judgements in accordance with the basic theories and concepts in the following areas, whilst demonstrating a reasonable level of skill in calculation and manipulation of the material: set theoretic description of probability, axioms of probability, random variables, examples of discrete and continuous distributions, generating functions, weak law of large numbers;

8.3 apply the underlying concepts and principles associated with probability in several well-defined contexts, showing an ability to evaluate the appropriateness of different approaches to solving problems in this area.

1. **The intended generic learning outcomes.  
   On successfully completing the module students will be able to:**

Demonstrate an increased ability to:

9.1 manage their own learning and make use of appropriate resources;

9.2 understand logical arguments, identifying the assumptions made and the conclusions drawn;

9.3 communicate straightforward arguments and conclusions reasonably accurately and clearly;

9.4 manage their time and use their organisational skills to plan and implement efficient and effective modes of working;

9.5 solve problems relating to qualitative and quantitative information;

9.6 make use of information technology skills such as online resources (moodle), internet communication;

9.7 communicate technical material competently.

9.8 demonstrate an increased level of skill in numeracy and computation.

1. **A synopsis of the curriculum**

Introduction to Probability. Concepts of events and sample space. Set theoretic description of probability, axioms of probability, interpretations of probability (objective and subjective probability).

Theory for unstructured sample spaces. Addition law for mutually exclusive events. Conditional probability. Independence. Law of total probability. Bayes' theorem. Permutations and combinations. Inclusion-Exclusion formula.

Discrete random variables. Concept of random variable (r.v.) and their distribution. Discrete r.v.: Probability function (p.f.). (Cumulative) distribution function (c.d.f.). Mean and variance of a discrete r.v. Examples: Binomial, Poisson, Geometric.

Continuous random variables. Probability density function; mean and variance; exponential, uniform and normal distributions; normal approximations: standardisation of the normal and use of tables. Transformation of a single r.v.

Joint distributions. Discrete r.v.’s; independent random variables; expectation and its application.

Generating functions. Idea of generating functions. Probability generating functions (pgfs) and moment generating functions (mgfs). Finding moments from pgfs and mgfs. Sums of independent random variables.

Laws of Large Numbers. Weak law of large numbers. Central Limit Theorem.

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

S. Ross, A First Course in Probability (9th ed.), Pearson, 2012.

J.H.McColl, Probability, Butterworth-Heinmann, 1995.

1. **Learning and teaching methods**

Total contact hours: 47

Private study hours: 103

Total study hours: 150

1. **Assessment methods**
   1. Main assessment methods

Assessment 1 Exercises, requiring on average between 10 and 15 hours to complete 15%

Assessment 2 Exercises, requiring on average between 10 and 15 hours to complete 15%

Examination 2 hours 70%

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)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |
| Private Study and Assessment | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures/exercise classes | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |
| Tutorials | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |
| Revision classes | **X** | **X** | **X** |  |  |  |  |  |  |  |  |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** |
| Coursework | **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

1. **Internationalisation**

This module is based on mathematical principles. Mathematics is an international language with techniques developed and refined by mathematicians across the globe. Mastery of the subject-specific learning outcomes, 8.1 to 8.3, 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.

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

**FACULTIES SUPPORT 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.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
| July 2023 | Minor | September 2023 | 13 | NO |
|  |  |  |  |  |