

# ST342-15 Mathematics of Random Events

**20/21**

**Department**

Statistics

**Level**

Undergraduate Level 3

**Module leader**

Leonardo Rolla

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

This module runs in Term 1 and aims to provide an introduction to this theory, concentrating on examples and applications. This course would particularly be useful for students willing to learn more about probability theory, analysis, mathematical finance, and theoretical statistics.

This module is available for students on a course where it is an optional core module or listed option and as an Unusual Option to students who have completed the prerequisite modules.

Pre-requisites:

Statistics Students: ST218 Mathematical Statistics A AND ST219 Mathematical Statistics B

Non-Statistics Students: ST220 Introduction to Mathematical Statistics

Leads to: ST318 Probability Theory.

[Module web page](#)

### Module aims

To introduce the concepts of measurable spaces, integral with respect to the Lebesgue measure,

independence and modes of convergence, and provide a basis for further studies in Probability, Statistics and Applied Mathematics. Imagine picking a real number  $x$  between 0 and 1 "at random" and with perfect accuracy, so that the probability that this number belongs to any interval within  $[0,1]$  is equal to the length of the interval. Can we compute the probability of  $x$  belonging to any subset to  $[0,1]$ ?

To answer this question rigorously we need to develop a mathematical framework in which we can model the notion of picking a real number "at random". The mathematics we need, called measure theory, permeates through much of modern mathematics, probability and statistics.

## Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

### I. Algebras, sigma-algebras and measures

Algebra and contents, sigma-algebra and measures, pi-systems, examples of random events and measurable sets.

### II. Lebesgue integration

Simple functions, standard representations, measurable functions, Lebesgue integral, properties of integrals, integration of Borel functions.

### III. Product measures, 2 lectures

Sections, product sigma-algebras, product measures, Fubini theorem.

### IV. Independence and conditional expectation 3 lectures

Independence of sigma-algebras, independence of random variables, conditional expectation with respect to a simple algebra.

### V. Convergence and modes of convergence

Borel-Cantelli lemma, Fatou lemma, dominated convergence theorem, modes of convergence of random variables, Markov inequality and application, weak and strong laws of large numbers.

## Learning outcomes

By the end of the module, students should be able to:

- Explain the properties of the probability spaces one can use for building models for simple experiments.
- Compute the probabilities of complicated events using countable additivity.
- Properly formulate the notion of statistical independence.
- Describe the basic theory of integration, particularly as applied to the expectation of random variables, and be able to compute expectations from first principles.
- Identify convergence in probability and almost sure convergence of sequences of random variables, and use and justify convergence in the computation of integrals and expectations.

## Indicative reading list

[View reading list on Talis Aspire](#)

## Subject specific skills

TBC

## Transferable skills

TBC

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## Study

### Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	5 sessions of 1 hour (3%)
Private study	115 hours (77%)
Total	150 hours

### Private study description

Weekly revision of lecture notes and materials, wider reading, practice exercises and preparing for examination.

### Costs

No further costs have been identified for this module.

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## Assessment

You do not need to pass all assessment components to pass the module.

### Assessment group B1

	Weighting	Study time	Eligible for self-certification
Online Examination	100%		No

The examination paper will contain four questions, of which the best marks of THREE questions will be used to calculate your grade.

~Platforms - Moodle

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- Answerbook Pink (12 page)

## Assessment group R

	Weighting	Study time	Eligible for self-certification
Online Examination - Resit	100%		No

The examination paper will contain four questions, of which the best marks of THREE questions will be used to calculate your grade.

~Platforms - Moodle

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- Answerbook Pink (12 page)

## Feedback on assessment

Solutions and cohort level feedback will be provided for the examination. The results of the January examination will be available by the end of week 10 of term 2.

[Past exam papers for ST342](#)

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## Availability

### Anti-requisite modules

If you take this module, you cannot also take:

- MA359-15 Measure Theory

## Courses

This module is Core optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated
  - Year 3 of G30E Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream) Int
  - Year 4 of G30E Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream) Int

This module is Optional for:

- Year 3 of UCSA-G4G1 Undergraduate Discrete Mathematics
- Year 3 of UCSA-G4G3 Undergraduate Discrete Mathematics

- Year 4 of UCSA-G4G2 Undergraduate Discrete Mathematics with Intercalated Year
- USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
  - Year 3 of G300 Mathematics, Operational Research, Statistics and Economics
  - Year 4 of G300 Mathematics, Operational Research, Statistics and Economics

This module is Core option list B for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated)
  - Year 3 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
  - Year 4 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list A for:

- Year 3 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)
- Year 3 of USTA-Y602 Undergraduate Mathematics, Operational Research, Statistics and Economics

This module is Option list B for:

- Year 3 of USTA-G302 Undergraduate Data Science
- Year 3 of USTA-G304 Undergraduate Data Science (MSci)
- Year 4 of USTA-G303 Undergraduate Data Science (with Intercalated Year)