

ST229-10 Probability for Mathematical Statistics

26/27

Department

Statistics

Level

Undergraduate Level 2

Module leader

Elke Thonnes

Credit value

10

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This module introduces core concepts in Probability and Statistics that are needed for further modules in both Probability and Statistics.

Pre-requisites:

- ST118 Probability 1, ST119 Probability 2, and ST117 Introduction to Statistical Modelling, or equivalents.

This module is core for students with their home department in Statistics.

It is **not** available to other students, for whom ST232/ST233 Introduction to Mathematical Statistics or ST352 Introduction to Mathematical Statistics (for Finalists) is provided as an alternative.

Leads to. This module is a pre-requisite for ST230 Mathematical Statistics and a number of ST3 and ST4 modules.

[Module web page](#)

Module aims

The first-year modules “Probability 1 and 2” and “Introduction to Statistical Modelling” introduce, respectively, a solid foundation in the mathematical formalisation of probability, and the fundamentals of statistical modelling and statistical inference. This module provides a bridge between these foundational topics, and the more advanced modules in year 3 and 4. Most of these advanced topics require the use of probability distributions over more than one random variable. This module focuses on the mathematical properties of such distributions, and the consequences of these properties in the context of statistical modelling and inference.

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.

This module introduces the systematic study of the theory of mathematical statistics.

1. Statistical motivation for studying sample averages and joint distributions.
2. Definitions of joint, marginal and conditional distributions (discrete and continuous cases). Independent random variables. Conditional expectation and properties. Conditional variance and properties.
3. Multivariate Normal/Gaussian distribution, its properties and distributions related to it. Simulating Gaussian distributions.
4. Properties of finite sums and averages of random variables, expectation and variance of sample means, focusing on the Normal/ Gaussian distribution case.
5. Weak law of large numbers and the central limit theorem.

Learning outcomes

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

- Derive properties of finite and infinite sums and averages of random variables, including the central limit theorem. Describe its significance in statistics.
- Demonstrate knowledge of joint and conditional probability distributions, conditional expectation and conditional variance.
- State/derive and use the properties of multivariate Normal/Gaussian distribution and distributions related to Normal/Gaussian distribution.
- Communicate solutions to problems accurately with structured and coherent arguments.

Indicative reading list

[Reading lists can be found in Talis](#)

[Specific reading list for the module](#)

Subject specific skills

- Demonstrate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of mathematical problems.
- Select and apply appropriate mathematical and/or statistical techniques
- Create structured and coherent arguments communicating them in written form.

Transferable skills

- Problem-solving skills: The module requires students to solve problems presenting their conclusions as logical and coherent arguments.
 - Written communication skills: Students complete written assessments that require precise and unambiguous communication in the manner and style expected in mathematical sciences.
 - Verbal communication skills: Students are encouraged to discuss and debate formative assessment and lecture material within small-group tutorials sessions. Students can continually discuss specific aspects of the module with the module leader. This is facilitated by staff office hours.
 - Professionalism: Students work autonomously by developing and sustaining effective approaches to learning, including time-management, organisation, flexibility, creativity, collaboration and intellectual integrity.
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Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (20%)
Seminars	5 sessions of 1 hour (5%)
Tutorials	5 sessions of 1 hour (5%)
Private study	60 hours (60%)
Assessment	10 hours (10%)
Total	100 hours

Private study description

Weekly revision of lecture notes and materials, wider reading and practice exercises working on problem sets and preparing for the examination.

Costs

No further costs have been identified for this module.

Assessment

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

Assessment group D2

	Weighting	Study time	Eligible for self-certification
In term assessment	10%	8 hours	No

There will be approximately weekly problem sets. Each problem set will contain a number of individual questions based on the material delivered in the lectures. Problem sheets are supported by seminars, including both analytical and computational tasks. Assessment is based on solutions to the problems and engagement with in-class problems.

The preparation and completion time noted below refers to the amount of time in hours that a well-prepared student who has attended lectures and carried out an appropriate amount of independent study on the material could expect to spend on this assessment.

Centrally-timetabled examination (On-campus)	90%	2 hours	No
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You will be required to answer all questions on this examination paper. The study time notes refers to the length of the exam in hours.

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- Answerbook Pink (12 page)

Assessment group R2

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

You will be required to answer all questions on this examination paper.

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- Answerbook Pink (12 page)

Feedback on assessment

Individual feedback will be provided on problem sheets by class tutors.

Cohort-level feedback will be available on the exam.

Students are actively encouraged to make use of office hours to build up their understanding, and to view all their interactions with lecturers and class tutors as feedback.

Availability

Anti-requisite modules

If you take this module, you cannot also take:

- ST352-15 Introduction to Mathematical Statistics (for Finalists)
- ST233-15 Introduction to Mathematical Statistics
- ST232-15 Introduction to Mathematical Statistics

Courses

This module is Core for:

- USTA-G302 Undergraduate Data Science
 - Year 2 of G302 Data Science
 - Year 2 of G302 Data Science
- Year 2 of USTA-G304 Undergraduate Data Science (MSci)
- USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
 - Year 2 of G30A Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream)
 - Year 2 of G30J Master of Maths, Op.Res, Stats & Economics (Data Analysis Stream)
 - Year 2 of G30B Master of Maths, Op.Res, Stats & Economics (Econometrics and Mathematical Economics Stream)
 - Year 2 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)
 - Year 2 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)
 - Year 2 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
 - Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
 - Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
 - Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 2 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
 - Year 2 of GG14 Mathematics and Statistics
 - Year 2 of GG14 Mathematics and Statistics
- USTA-Y602 Undergraduate Mathematics, Operational Research, Statistics and Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics