ST228-10 Mathematical Methods for Statistics and Probability

24/25

Department
>   Statistics

Level
>   Undergraduate Level 2

Module leader
>   Martyn Parker

Credit value
>   10

Module duration
>   10 weeks

Assessment
>   Multiple

Study location
>   University of Warwick main campus, Coventry

Description

Introductory description

This module develops and motivate techniques which are in everyday use in probability and statistics, and which are essential to a proper understanding of any second- or third-year course in these subjects. It provides the mathematical background for optimization, regression, and best approximation, and develops mathematical thinking.

This module is core for students with their home department in Statistics, optional for students studying Discrete Mathematics. The module may be available to students from other departments as an unusual option if they have taken the necessary prerequisites.

Pre-requisites

- (MA148 Linear Algebra/MA149 Vectors and Matrices) AND (MA140 Mathematical Analysis 2/MA143 Calculus 2) or equivalents.

To be taken together with:

- ST229 Probability for Mathematical Statistics (Statistics Department students),
- Other students take ST232/ST233.

Leads to:

- ST230 Mathematical Statistics (Statistics Department students).

and other Year 2/3 and 4 modules.

Module aims

The module's aims are:

1. Develop students' mathematical knowledge in multivariable differentiation and integration, matrix theory and linear algebra.

2. Apply this mathematical knowledge to build advanced probabilistic methods used in statistics such as multivariate probability distributions and conditional distributions.

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 provides interdisciplinary coverage of mathematical techniques applying them to advanced probabilistic methods. The module covers:

1. Multivariable integration and its application to multivariate distributions.
2. Differentiation in multidimensions and applications to optimisation problems, including constrained optimisation.
3. The theory of symmetric matrices and application to covariances matrices.
4. Inner product spaces, orthogonalization which leads to linear regression in statistics.

Learning outcomes

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

- analyse multiple integrals and optimisation problems, then select and apply appropriate techniques to solve these problems.
- analyse matrices and vector spaces, then apply spectral theory to determine their structural properties
- analyse and evaluate different strategies to solve mathematical and probabilistic problems, sometimes in multidimensional contexts.
- communicate solutions to problems accurately with structured and coherent arguments.

Indicative reading list

K. F. Riley; M. P. Hobson; S. J. Bence, Mathematical methods for physics and engineering: a comprehensive guide. 2002, Cambridge University Press. ISBN: 0521813727, 0521890675 (Available online and in print in the Main Campus Library.)

Jim Pitman, Probability. 1999. Springer-Verlag New York Inc. ISBN: 9780387979748. (Available online and in print in the Main Campus Library.)

Allan Gut. An intermediate course in probability. 2009. Springer. ISBN: 9781441901620. Available online and in print in the Main Campus Library.)

[View reading list on Talis Aspire](#)

Interdisciplinary

This module breaks through domain specificity to delivery an interdisciplinary experience where neither mathematics nor statistics are privileged disciplines and discipline distinctions disappear.

Subject specific skills

Demonstrate facility with advanced mathematical and probabilistic methods.

Demonstrate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of mathematical problems

Create structured and coherent arguments communicating them in written form

Analyse problems, abstracting their essential information formulating them using appropriate mathematical language to facilitate their solution.

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 statistics staff office hours.

Teaming working and working effectively with others: Students are encouraged to discuss and debate formative assessment and lecture material within small-group tutorials sessions.

Professionalism: Students work autonomously by developing and sustain effective approaches to learning, including time management, organisation, flexibility, creativity, collaboratively and intellectual integrity.

Study

Study time

Type	Required	Optional
Lectures	20 sessions of 1 hour (20%)	2 sessions of 1 hour
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 D1

	Weighting	Study time
In term assessment	10%	8 hours

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.

	Weighting	Study time
Mathematical Methods for Statistics and Probability examination	90%	2 hours

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

- Answerbook Pink (12 page)
- Students may use a calculator
- Graph paper

Assessment group R1

	Weighting	Study time
In-person Examination - Resit	100%	

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

- Answerbook Pink (12 page)
- Students may use a calculator
- Graph paper

Feedback on assessment

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

Solutions and cohort level feedback will be provided for the examination

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.

[Past exam papers for ST228](#)

Availability

Courses

This module is Core for:

- USTA-G302 Undergraduate Data Science
  - Year 2 of G302 Data Science
  - Year 2 of G302 Data Science
- 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