ST226-12 Introduction to Mathematical Statistics

21/22

Department
Statistics
Level
Undergraduate Level 2
Module leader
Alice Kirichenko
Credit value
12
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module runs in Term 1 and is optional for students from outside the Statistics department and *not* their second year. It is of particular relevance to students who may be interested in taking third year Statistics modules.
Students from outside Statistics and in their second year should take 'ST220-12 Introduction to Mathematical Statistics' instead, which is identical to this module.

This module is not available to students who have their home department in Statistics, who take equivalent modules.

Prerequisites: ST111 Probability A and ST112 Probability B
Leads to: Many ST3 modules.

Module web page

Module aims

This module is designed for students in the Mathematics, Computer Science and other non-Statistics departments. It will introduce the main ideas of statistical inference emphasising the use

of likelihood for estimation and testing. These ideas are fundamental to the use of statistics in modern applications such as mathematical finance, telecommunications, bioinformatics as well as more traditional areas such as insurance, engineering and the social sciences.

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.

1. Standard families of Probability distributions: Binomial, Geometric, Poisson, Exponential, Gamma, Gaussian.
2. The weak law of large numbers and central limit theorem.
3. The Multivariate Gaussian distribution. Orthogonality and Independence for jointly Gaussian random variables.
   Distributions derived from the Gaussian: Chi-squared, t and F.
4. The notion of a parametrized Statistical model, and examples.
5. Likelihood including maximum likelihood estimates and use of likelihood ratios to compare hypotheses.
6. The repeated sampling principle: bias and MSE, confidence intervals and p-values.
7. Fisher's theorem on Gaussian sampling, and its extension to linear regression.

Learning outcomes

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

- Understand more advanced notions of probability needed in mathematical statistics including properties of multivariate Gaussian distributions, the law of large numbers, and the central limit theorem.
- Understand the main notions of statistical inference including a (parametrized) statistical model, an estimator and its sampling distribution, and hypothesis tests.
- Be able to calculate maximum likelihood estimators in a variety of examples. Be able to derive properties of sampling distributions of estimators in a variety of examples, and thereby construct confidence intervals.
- Be able to use likelihood ratios to construct hypothesis tests in a variety of examples including the classical t and F tests.

Indicative reading list

View reading list on Talis Aspire

Subject specific skills

TBC

Transferable skills

TBC

Study

Study time

Type	Required	Optional
Lectures	30 sessions of 1 hour (25%)	2 sessions of 1 hour
Tutorials	5 sessions of 1 hour (4%)	
Private study	73 hours (61%)	
Assessment	12 hours (10%)	
Total	120 hours	

Private study description

Weekly revision of lecture notes and materials, wider reading and practice exercises, working on problem sets and preparing for examination.
There will be fortnightly problem sets which will be marked and returned with feedback in tutorials.

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 D

	Weighting	Study time
Multiple Choice Quiz 1	2%	3 hours
A multiple choice quiz which will take place during the term that the module is delivered.		
Multiple Choice Quiz 2	3%	3 hours
A multiple choice quiz which will take place during the term that the module is delivered.		
Multiple Choice Quiz 3	2%	3 hours
A multiple choice quiz which will take place during the term that the module is delivered.		
Multiple Choice Quiz 4	3%	3 hours
A multiple choice quiz which will take place during the term that the module is delivered.		
On-campus Examination	90%	

	Weighting	Study time

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

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

Assessment group R

	Weighting	Study time
In-person Examination - Resit	100%	

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

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

Feedback on assessment

Answers to the formative problems sets will be marked and returned to students in a tutorial or seminar taking place the following week when students will have the opportunity to discuss it.

Solutions and cohort level feedback will be provided for the examination.

Past exam papers for ST226

Availability

Anti-requisite modules

If you take this module, you cannot also take:

- ST218-12 Mathematical Statistics Part A
- ST219-12 Mathematical Statistics Part B
- ST220-12 Introduction to Mathematical Statistics

Courses

This module is Option list B for:

- Year 3 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)

- UMAA-G100 Undergraduate Mathematics (BSc)
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
- Year 3 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year