

# ST301-15 Bayesian Statistics and Decision Theory

**22/23**

**Department**

Statistics

**Level**

Undergraduate Level 3

**Module leader**

Mark Steel

**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 demonstrate how to build Bayesian models and to train students in the rudiments of decision analysis. It is available for students on a course where it is a 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

Results from this module can be partly used to determine exemption eligibility in the Institute and Faculty of Actuaries (IFoA) module CS1 Actuarial Statistics.

[Module web page](#)

### Module aims

Bayesian statistics is one of the fastest growing areas in statistics. With the advance of computer technology it is now a highly practical methodology for addressing many important high dimensional decision problems as well as being underpinned by a sound mathematical foundation.

It is especially useful when some of the components of uncertainty have only sparsely collected data associated with them, so that expert judgements need to be incorporated.

## 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.

- Loss/pay-off functions.
- Posterior updating.
- Idiot Bayes.
- Decision trees and the extensive form solution.
- Utility functions — use and elicitation.
- Multiattribute utility functions.
- Forecast scoring.
- The normal form solution.
- DAGS.
- Conjugate priors.

## Learning outcomes

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

- To understand how Bayesian models are built and evaluated. Appreciate idiot Bayes models and issues such as calibration.
- To perform basic prior to posterior analysis. To perform discrete prior to posterior inference and beta and Dirichlet conjugate analysis.
- To understand the foundation of utility theory and apply it in a multi-attribute context. To be able to elicit a utility function.
- To understand how to model complicated systems in terms of conditional independences. To appreciate the structuring of models through DAGs. To be able to estimate probabilities in DAGs using conjugate product Dirichlet distributions.

## 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	Optional
Lectures	30 sessions of 1 hour (20%)	2 sessions of 1 hour
Tutorials	4 sessions of 1 hour (3%)	
Private study	116 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 must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

### Assessment group B3

	Weighting	Study time
In-person Examination	100%	

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

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

### Assessment group R2

	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.

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## Weighting

## Study time

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

## Feedback on assessment

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

[Past exam papers for ST301](#)

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## Availability

### Anti-requisite modules

If you take this module, you cannot also take:

- ST413-15 Bayesian Statistics and Decision Theory with Advanced Topics

## Courses

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-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)
- 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
- Year 3 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 4 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)

This module is Core option list A 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 G30G Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream) Int
  - Year 4 of G30G Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream) Int

This module is Option list A for:

- USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
  - Year 3 of G1G3 Mathematics and Statistics (BSc MMathStat)
  - Year 4 of G1G3 Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
  - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
  - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
- 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
- Year 4 of USTA-Y603 Undergraduate Mathematics, Operational Research, Statistics, Economics (with Intercalated Year)

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)
- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
  - Year 4 of G105 Mathematics (MMath) with Intercalated Year
  - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- 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)
  - 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
- UMAA-G100 Undergraduate Mathematics (BSc)
  - Year 3 of G100 Mathematics
  - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 3 of G103 Mathematics (MMath)
  - Year 3 of G103 Mathematics (MMath)
  - Year 4 of G103 Mathematics (MMath)
  - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
  - Year 3 of G106 Mathematics (MMath) with Study in Europe
  - Year 4 of G106 Mathematics (MMath) with Study in Europe
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year

This module is Option list E for:

- Year 4 of USTA-G300 Undergraduate Master of Mathematics, Operational

Research, Statistics and Economics

- Year 5 of USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated

This module is Option list F 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)