

ST405-15 Bayesian Forecasting and Intervention with Advanced Topics

23/24

Department

Statistics

Level

Undergraduate Level 4

Module leader

Haotian Xu

Credit value

15

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This module runs in Term 2 and is concerned with the theory and practice of short-term forecasting, using both data and subjective information. The course focuses on Dynamic Linear Models (DLM). DLM's are a class of Bayesian Forecasting Models which generalise linear regression models and static statistical linear models. Some extensions to nonlinear dynamic models are also considered.

Students will be given selected advanced research material for independent study and examination.

This module 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

[Module web page](#)

Module aims

Forecasting is a vital prerequisite to decision making. This course offers a very powerful fundamental probabilistic approach to forecasting, controlling and learning about uncertain commercial, financial, economic, production, environmental and medical dynamic systems. The theory will be illustrated by real examples from industry, marketing, finance, government, agriculture etc.

A familiarity with the material in this module will be very useful to all students planning a career involving a component of industrial, business or government 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.

- State space modelling
- Bayesian updating of beliefs
- Specifying Dynamic Linear Models
- Updating Dynamic Linear Models, forecasting
- Building Dynamic Linear Models, accommodating external information
- ARIMA models, stationarity
- Understand by independent study an additional advanced topic in Bayesian Forecasting & Intervention

Learning outcomes

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

- Acquire an appreciation of forecasting recurrences and be able to calculate these for special cases.
- Know how to select an appropriate model in simple scenarios
- Have an acquaintance with the most useful models in the class of DLMs for statistical models in a business environment.
- Know how to intervene in these processes in the light of external information
- Have an appreciation of diagnostics methods and estimation techniques for this model class.
- Understand how to deal with non-linearity in a model using sequential Monte Carlo techniques
- To understand by independent study selected advanced research material

Indicative reading list

[View reading list on Talis Aspire](#)

Subject specific skills

- Demonstrate facility with rigorous statistical methods.

- Evaluate, select and apply appropriate mathematical and/or statistical techniques.
- Demonstrate knowledge of and facility with formal statistical concepts, both explicitly and by applying them to the solution of mathematical problems.
- Create structured and coherent arguments communicating them in written form.
- Construct logical arguments with clear identification of assumptions and conclusions.
- Reason critically, carefully, and logically.

Transferable skills

- **Problem solving:** Use rational and logical reasoning to deduce appropriate and well-reasoned conclusions. Retain an open mind, optimistic of finding solutions, thinking laterally and creatively to look beyond the obvious. Know how to learn from failure.
- **Self awareness:** Reflect on learning, seeking feedback on and evaluating personal practices, strengths and opportunities for personal growth.
- **Communication:** Present arguments, knowledge and ideas, in a range of formats.
- **Professionalism:** Prepared to operate autonomously. Aware of how to be efficient and resilient. Manage priorities and time. Self-motivated, setting and achieving goals, prioritising tasks.

Study

Study time

Type	Required	Optional
Lectures	30 sessions of 1 hour (20%)	2 sessions of 1 hour
Private study	120 hours (80%)	
Total	150 hours	

Private study description

Study of advanced topic, 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.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group B4

	Weighting	Study time
On-campus Examination	100%	

The examination will contain one compulsory question on the advanced topic and four additional questions of which the best marks of TWO questions will be used to calculate your grade.

- Cambridge Statistical Tables (blue)
- Answerbook Pink (12 page)
- Students may use a calculator

Assessment group R2

	Weighting	Study time
On-campus Examination - Resit	100%	

The examination will contain one compulsory question on the advanced topic and four additional questions of which the best marks of TWO questions will be used to calculate your grade.

- Answerbook Pink (12 page)
- Students may use a calculator
- Cambridge Statistical Tables (blue)

Feedback on assessment

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

[Past exam papers for ST405](#)

Availability

Anti-requisite modules

If you take this module, you cannot also take:

- ST337-15 Bayesian Forecasting and Intervention

Courses

This module is Optional for:

- TMAA-G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TIBS-N3G1 Postgraduate Taught Financial Mathematics
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PF Postgraduate Taught Mathematics of Systems
- Year 1 of TSTA-G4P1 Postgraduate Taught Statistics
- 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 Option list A 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
- 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)

This module is Option list B for:

- Year 4 of USTA-G304 Undergraduate Data Science (MSci)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 5 of UCSA-G4G4 Undergraduate Discrete Mathematics (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 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 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)