1. **Title of the module**

MAST6390 (MA639) Time Series Modelling and Simulation

1. **School or partner institution which will be responsible for management of the module**

School of Mathematics, Statistics and Actuarial Science

1. **The level of the module (e.g. Level 4, Level 5, Level 6 or Level 7)**

Level 6

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Spring

1. **Prerequisite and co-requisite modules**

Pre-requisite: MAST5007 Mathematical Statistics (or equivalent) or MACT7290 Probability and Statistics for Actuarial Science

Co-requisite: None

1. **The programmes of study to which the module contributes**

BSc (Hons) Mathematics, BSc (Hons) Mathematics & Statistics, BSc (Hons) Mathematics and Accounting & Finance, BSc (Hons) Financial Mathematics (including programmes with a year in industry), BSc (Hons) Mathematics with a Foundation Year, MMath Mathematics, MMathStat Mathematics and Statistics, MSc Actuarial Science (and with an Industrial Placement), MSc in Applied Actuarial Science (International Master’s) (and with an industrial placement).

1. **The intended subject specific learning outcomes**

**On successfully completing this module students will be able to:**

* 1. demonstrate systematic understanding of key aspects of time series modelling and simulation;
	2. demonstrate the capability to deploy established approaches accurately to analyse and solve problems using a reasonable level of skill in calculation and manipulation of the material in the following areas: ARIMA and GARCH time series models including those modelling seasonality, main methods for simulating random variates;
	3. apply key aspects of time series modelling in well-defined contexts, showing judgement in the selection and application of tools and techniques.
1. **The intended generic learning outcomes.**

 **On successfully completing this module students will be able to**:

* 1. manage their own learning and make use of appropriate resources;
	2. understand logical arguments, identifying the assumptions made and the conclusions drawn;
	3. communicate straightforward arguments and conclusions reasonably accurately and clearly and communicate technical material competently;
	4. manage their time and use their organisational skills to plan and implement efficient and effective modes of working;
	5. solve problems relating to qualitative and quantitative information;
	6. make competent use of information technology skills such as online resources (Moodle);
	7. communicate technical material competently;
	8. demonstrate an increased level of skill in numeracy and computation;
	9. demonstrate the acquisition of the study skills needed for continuing professional development.
1. **A synopsis of the curriculum**

**Stationary Time Series**: Stationarity, autocovariance and autocorrelation functions, partial autocorrelation functions, ARMA processes.

**ARIMA Model Building and Testing**: estimation, Box-Jenkins, criteria for choosing between models, diagnostic tests for residuals of a time series after estimation.

**Forecasting**: Holt-Winters, Box-Jenkins, prediction bounds.

**Testing for Trends and Unit Roots**: Dickey-Fuller, ADF, structural change, trend-stationarity vs difference stationarity.

**Seasonality and Volatility**: ARCH, GARCH, ML estimation.

**Multiequation Time Series Models**: transfer function models, vector autoregressive moving average (*VARM(p,q))* models, impulse responses.

**Spectral Analysis**: spectral distribution and density functions, linear filters, estimation in the frequency domain, periodogram.

**Simulation**: generation of pseudo-random numbers, random variate generation by the inverse transform, acceptance rejection. Normal random variate generation: design issues and sensitivity analysis.

1. **Reading List (Indicative list, current at time of publication. Reading lists will be published annually)**

Enders, W. (2004), Applied Econometric Time Series, New York: Wiley.

Brockwell, P.J., and Davis, R. A. (2002), Introduction to Time Series Analysis and Forecasting, New York: Springer-Verlag.

Morgan, B. J. T. (1984), Elements of Simulation, London: Chapman & Hall/CRC.

1. **Learning and Teaching methods**

Total contact hours: 46

Private study hours: 104

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Assessment 1 Exercises, requiring on average between 10 and 15 hours to complete 15%

Assessment 2 Exercises, requiring on average between 10 and 15 hours to complete 15%

Examination 2 hours 70%

The coursework mark alone will not be sufficient to demonstrate the student’s level of achievement on the module.

13.2 Reassessment Methods

Like-for-like

1. ***Map of Module Learning Outcomes (sections 8 & 9) to Learning and Teaching Methods (section12) and methods of Assessment (section 13)***

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 | 9.9 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |
| Private Study | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures/Exercise classes | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| Revision class | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** |
| Coursework | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered:** Canterbury
2. **Internationalisation**

This module is based on mathematical principles. Mathematics is an international language with techniques developed and refined by mathematicians across the globe. Mastery of the subject-specific learning outcomes, 8.1 to 8.3, will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Mathematics, Statistics and Actuarial Science, which includes many members of staff with international experience of teaching and research collaboration.

In compiling the reading list, consideration has been given to the range of texts that are available internationally and a selection of texts has been identified to complement the delivery of the material.

Examples with an international dimension are included in the module where appropriate.

The support SMSAS provides to its students is also internationally attuned given our international student body.

**FACULTIES SUPPORT OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs( Q6&7 cover sheet) |
| July 2023 | Minor | Spring 2023 | 13 |  |
|  |  |  |  |  |