Ollscoil Chathair
Bhaile Átha Cliath
Dublin City University

Module Specifications.

Current Academic Year 2024 - 2025

All Module information is indicative, and this portal is an interim interface pending the full upgrade of Coursebuilder and subsequent integration to the new DCU Student Information System (DCU Key).

As such, this is a point in time view of data which will be refreshed periodically. Some fields/data may not yet be available pending the completion of the full Coursebuilder upgrade and integration project. We will post status updates as they become available. Thank you for your patience and understanding.

Date posted: September 2024

Module Title	Time Series Intermediate)		
Module Code	MS447 (ITS) / MTH1003 (Banner)		
Faculty	Science & Health	**School**	Mathematical Sciences
Module Co-ordinator	John Appleby		
Module Teachers	-		
NFQ level	8	**Credit Rating**	7.5
Pre-requisite	Not Available		
Co-requisite	Not Available		
Compatibles	Not Available		
Incompatibles	Not Available		

None

Description

The module introduces the main concepts underlying the analysis of Time Series models: it concerns the stationarity of linear time series and some related models. It covers the syllabus of the Time Series part of the Institute of Actuaries subject CS2, giving students of actuarial programmes an opportunity to be recommended for an exemption from the professional examination in this subject. It is an advanced level undergraduate course with a substantial theoretical component as well as hands-on experience in fitting data to models using computers.

Learning Outcomes

1. prove whether given time series models are weakly or strictly stationary
2. establish the important properties of moving average models, and to apply them to model financial phenomena
3. characterise the class of linear autoregressive models which possess unique attracting stationary solutions, and to apply these processes to model financial phenomena
4. Reduce time series data and models to the stationary case, and to fit these data sets to the appropriate linear time series model using statistical packages
5. Model multidimensional discrete time stochastic economic phenomena, and analyse these models as vector autoregressive models
6. Analyse other important non-ARIMA time series models

Workload	**Full-time hours per semester**	
Type	***Hours***	***Description***
Lecture	32	Lectures
Tutorial	10	Working from supplied tutorial sheets
Laboratory	6	Practical computer labs - mixture of presentations and students working from supplied lab sheets

Independent Study	140	Self study

Total Workload: 188

All module information is indicative and subject to change. For further information,students are advised to refer to the University's Marks and Standards and Programme Specific Regulations at: http://www.dcu.ie/registry/examinations/index.shtml

Indicative Content and Learning Activities

Stationary processes
Strict and weak stationary, autocovariance function, integrated time series. Linear time series models. Wold's decomposition theorem. Partial autocorrelation function. [CS2 – 2.1.1-3]

Moving average time series
Linear difference equations. Stationarity and invertibility of moving average models. Invertibility of general linear processes. Operator algebra. Applications to modelling inefficient financial markets [CS2 – 2.1.4-6, 2.2.4]

Linear autoregressive time series
AR(p) time series. Characterisation of stationarity. Stationary solutions and uniqueness. Applications to volatility and interest rate modelling. ARMA(p,q) models, in particular ARMA(1,1). Markov property of AR-type models. [CS2 – 2.1.4-5,2.1.9, 2.2.3]

Non-stationarity and ARIMA models
ARIMA models. Transient nonstationarity. Stability of stationarity under differencing. Reducing time series to stationary series. Economic modelling of bubbles and seasonal behaviour. [CS2 – 2.1.5, 2.2.4]

Fitting and Prediction in ARIMA models
Box-Jenkins method for fitting linear time series. Statistical testing for white noise, moving average, autoregressive models. The prediction operator and forecasting. [CS2 – 2.2.1, 2.2.4]

Multidimensional time series models
Multidimensional covariance function. Multidimensional white noise. Vector autogressive (VAR) processes. Stationarity and cointegration. Using VAR to model dynamic economic phenomena. [CS2 – 2.1.7-9, 2.2.3-4]

Further time series models
Properties and applications of bilinear, TAR and ARCH-type models [CS2 – 2.2.2]

Assessment Breakdown

Continuous Assessment 30% Examination Weight 70%

Course Work Breakdown

Type	Description	% of total	Assessment Date
In Class Test	n/a	10%	Week 8
In Class Test	Computer laboratory examination using the R programming language	20%	Week 11

Indicative Reading List

- **J. Franke, W. Hardle, C. Hafner.:** 2003, Statistics of Financial Markets, Springer,
- **P. Brockwell, R. Davis.:** 1991, Time Series: Theory and Methods, Springer,
- **C. Chatfield:** 2004, The Analysis of Time Series: An introduction, 6th ed., Chapman and Hall,

Other Resources

None

Code remains MS447. There should be a change in the assessment breakdown to 70% exam, 30% continuous assessment to reflect the changes approved at the March 2022 School Teaching Meeting.

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