

MA930-15 Data Analysis and Machine Learning

20/21

Department

Warwick Mathematics Institute

Level

Taught Postgraduate Level

Module leader

Jade Perkins

Credit value

15

Module duration

5 weeks

Assessment

20% coursework, 80% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

N/A.

Module aims

This is a core module for the MSc in Mathematics of Systems. The main aims are to provide the students with a broad knowledge of modern techniques of exploratory data analysis, time series modelling and forecasting, spectral analysis data assimilation and machine learning.

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.

Basic probability: distributions characteristic functions.

Basic statistics: sample mean and variance, law of large numbers and central-limit theorem

Frequentist statistics: point estimation, confidence intervals, type-I and II errors, hypothesis tests

Bayesian statistics: likelihood, maximum likelihood, Bayes theorem, conjugate priors, credible intervals

Spectral methods for time-series analysis Ornstein-Uhlenbeck process, autocovariance, power spectrum, Weiner-Khinchin theorem

Machine-learning approaches to data analysis: gradient descent, logistic regression, linear classifier, neural networks, backpropagation and networks with hidden layers.

Learning outcomes

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

- By the end of this module, the students will be able to quantitatively summarise and critically assess data from real-world systems.
- By the end of this module, the students will be able to use modern methods of parameter estimation to model and forecast time-series data.
- By the end of this module, the students will be able to compute and interpret spectral representations of time-series data and incorporate observations into mathematical models to reduce the uncertainty in predictions made using these models.

Indicative reading list

C.M. Bishop, Pattern Recognition and Machine Learning, Springer 2006

J.D. Hamilton, Time Series Analysis, Princeton University Press 1994

G.E.P. Box, G.M. Jenkins and G.C. Reisel, Time Series Analysis: Forecasting and Control, Prentice Hall 1994

Notes and scientific literature provided during lectures

Subject specific skills

See learning outcomes.

Transferable skills

Students will acquire key reasoning and problem solving skills which will empower them to address new problems with confidence.

Study

Study time

Type	Required
Lectures	10 sessions of 2 hours (7%)
Tutorials	10 sessions of 2 hours (7%)
Private study	110 hours (37%)
Assessment	150 hours (50%)
Total	300 hours

Private study description

Self-study and preparation for exam.

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
Assessed Coursework	20%	33 hours
Written Examination	40%	58 hours 30 minutes
Examination may be delivered online depending on local and national restrictions in place at the time as a result of the COVID-19 pandemic.		
Oral Examination	40%	58 hours 30 minutes
Vivas may be delivered online depending on local and national restrictions in place at the time as a result of the COVID-19 pandemic.		

Feedback on assessment

Written feedback on written assignments plus informal oral feedback during classwork sessions.

Oral feedback on the oral examination.

Written feedback on the written examination.

[Past exam papers for MA930](#)

Availability

Courses

This module is Core for:

- RMAA-G1PG Postgraduate Research Mathematics of Systems
 - Year 1 of G1PG Mathematics of Systems
 - Year 1 of G1PG Mathematics of Systems
- TMAA-G1PF Postgraduate Taught Mathematics of Systems
 - Year 1 of G1PF Mathematics of Systems
 - Year 1 of G1PF Mathematics of Systems

This module is Optional for:

- Year 2 of TPXA-F345 Postgraduate Taught Modelling of Heterogeneous Systems (PGDip)

This module is Option list B for:

- Year 1 of TPXA-F345 Postgraduate Taught Modelling of Heterogeneous Systems (PGDip)