

MA398-15 Matrix Analysis & Algorithms

20/21

Department

Warwick Mathematics Institute

Level

Undergraduate Level 3

Module leader

Radu Cimpanu

Credit value

15

Module duration

10 weeks

Assessment

15% coursework, 85% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

Many large scale problems arising in data analysis and scientific computing require to solve systems of linear equations, least-squares problems, and eigenvalue problems, for which highly efficient solvers are required. The module will be based around understanding the mathematical principles underlying the design and the analysis of effective methods and algorithms.

[Module web page](#)

Module aims

Understanding how to construct algorithms for solving some problems central in numerical linear algebra and to analyse them with respect to accuracy and computational cost.

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.

Many large scale problems arising in data analysis and scientific computing require efficient

solutions to systems of linear equations, least-squares problems, and eigenvalue problems. The module is based around understanding the mathematical principles underlying the design and the analysis of effective methods and algorithms to solve these types of challenges. Key concepts include matrix decompositions, factorisations and iterative solvers. They are supported by fundamental aspects related to floating point arithmetic, computational cost analysis, stability and convergence.

Learning outcomes

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

- At the end of the module you will familiar with concepts and ideas related to: various matrix factorisations as the theoretical basis for algorithms,
- assessing algorithms with respect to computational cost,
- conditioning of problems and stability of algorithms,
- direct versus iterative methods.

Indicative reading list

AM Stuart and J Voss, Matrix Analysis and Algorithms, script.

G Golub and C van Loan, Matrix Computations, 3. ed., Johns Hopkins Univ. Press, London 1996.

NJ Higham, Accuracy and Stability of Numerical Algorithms, SIAM 1996.

RA Horn and CR Johnson, Matrix Analysis, Cambridge University Press 1985.

D Kincaid and W Cheney, Numerical Analysis, 3. ed., AMS 2002.

LN Trefethen and D Bau, Numerical Linear Algebra, SIAM 1997.

Subject specific skills

Discrete mathematical analysis, algorithmic construction, cost analysis, concepts in numerical methods for applied problems.

Transferable skills

Informed problem solving, software development, creative solution analysis, project management, critical thinking, application-oriented solution strategy design, programming language expertise.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	9 sessions of 1 hour (6%)
Total	150 hours

Type	Required
Private study	111 hours (74%)
Total	150 hours

Private study description

Review lectured material and work on set exercises.

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 D1

	Weighting	Study time
Assignment	15%	
Online Examination	85%	

- Answerbook Gold (24 page)

Feedback on assessment

Marked assignments and exam feedback.

[Past exam papers for MA398](#)

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- UCSA-G4G1 Undergraduate Discrete Mathematics
 - Year 3 of G4G1 Discrete Mathematics
 - Year 3 of G4G1 Discrete Mathematics

- Year 3 of UCSA-G4G3 Undergraduate Discrete Mathematics
- 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

This module is Core option list B for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
- Year 3 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- 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)
- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
 - Year 3 of G105 Mathematics (MMath) with Intercalated Year
 - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G100 Undergraduate Mathematics (BSc)
 - Year 3 of G100 Mathematics
 - Year 3 of G100 Mathematics
 - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
 - Year 3 of G100 Mathematics
 - 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 3 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
 - Year 3 of GF13 Mathematics and Physics
 - Year 3 of GF13 Mathematics and Physics
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)

- Year 3 of FG31 Mathematics and Physics (MMathPhys)
- Year 3 of FG31 Mathematics and Physics (MMathPhys)
- Year 4 of UPXA-GF14 Undergraduate Mathematics and Physics (with Intercalated Year)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
 - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
 - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics

This module is Option list B for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
 - Year 3 of GG14 Mathematics and Statistics
 - Year 3 of GG14 Mathematics and Statistics
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)

This module is Option list E for:

- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
 - Year 3 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
 - Year 4 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
- 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)
 - Year 5 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)