MODULE TITLE	**Fundamentals of Data Science**	**CREDIT VALUE**	**15**
MODULE CODE	**ECMM444**	**MODULE CONVENER**	**Dr Alberto Moraglio (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS	**11**	**0**	**0**

Number of Students Taking Module (anticipated)	**20**

DESCRIPTION - summary of the module content

Data science depends on a solid grounding in mathematics and programming. In this module, you will learn essential mathematical techniques from linear algebra and probability. You will also develop programming skills specific to data analysis, including how to apply the mathematical techniques you have learned as part of computational data analysis procedures. Other computational methods with direct relevance to data science and processing of large datasets will also be included, such as data analysis packages for Python, and optimisation techniques for speeding up large computations.
Overall, this module will ensure you have the core skills and background knowledge that underpin many central topics in data science, including machine learning, statistical modelling, network analysis and computer vision.â€¨
Pre-requisite modules: None
Co-requisite modules: None

AIMS - intentions of the module

The aim of this module is to equip you with the core mathematical and computational skills essential for further study of data science. Topics will be tailored to the cohort, to address diverse backgrounds and previous experience. At the end of the module, you should possess a solid grounding in aspects of linear algebra, probability, and computational methods that are common to many areas of data science.â€¨â€¨
Most taught content will be delivered as lectures and practical work. Lectures will be accompanied by data analysis exercises and practical sessions. The module will be completed through individual study and coursework, supported by the module staff. Assessment will include assessed practical exercises and coursework.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

On successful completion of this module ***you should be able to***:â€¨â€¨

Module Specific Skills and Knowledgeâ€¨â€¨:
1. Demonstrate competence in relevant aspects of linear algebra relevant to data science;
2. Demonstrate competence in aspects of probability;
3. Utilise a variety of computational methods relevant to data science.
Discipline Specific Skills and Knowledgeâ€¨â€¨:
4. Use linear algebra and probability theory as part of data analysis procedures;
5. Understand the underpinning mathematical principles commonly used in machine learning and statistical modelling;
6. Carry out linear algebra and probability theory operations using Python.
Personal and Key Transferable / Employment Skills and Knowledgeâ€¨â€¨:
7. Explain the relationship between mathematical principles and core techniques in data science;
8. Understand mathematical notation and use mathematical notation effectively to communicate to a specialised audience.

SYLLABUS PLAN - summary of the structure and academic content of the module

Topics will be chosen depending on the background and experience of the student cohort, but are likely to include:â€¨â€¨
- Aspects of linear algebra (e.g.): Vectors, Matrices, Systems of linear equations, Linear transformations, Eigenvalues and eigenvectors, Symmetry, Positive definite matrices, Singular value decompositions;
- Aspects of probability (e.g.): Basic probability, Marginal, conditional and joint probability, Bayes theorem, Probability distributions (the Normal, Gamma, Binomial and Bernoulli distributions), Central limit theorem, Moments, Multivariate distributions;
- Programming for data science in Python (e.g): Tools for handling data (Python: numpy, scipy, matplotlib, pandas), Linear algebra in code, Probability distributions and random numbers, Notebooks/markdown;
- Aspects of optimisation (e.g.): Linear least-squares, Gradient descent, Convexity (local vs global extrema), Linear programming;
- Other topics may be included as appropriate to the skills and background of the student cohort.

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	36.00	**Guided Independent Study**	114.00	**Placement / Study Abroad**	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled Learning and Teaching	16	Lectures
Scheduled Learning and Teaching	20	Practicals and exercises
Guided Independent Study	50	Coursework and associated preparation
Guided Independent Study	64	Exercises and background reading

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Practical Exercises	20 hours	All	Oral

SUMMATIVE ASSESSMENT (% of credit)

Coursework	100	**Written Exams**	0	**Practical Exams**	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Coursework exercises	40	1000 words	All	Written
Coursework report	60	1000 words	All	Written

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-assessment
Coursework exercises	Coursework exercises	All	August Ref/Def Period
Coursework report	Coursework report	All	August Ref/Def Period

RE-ASSESSMENT NOTES

Reassessment will be by coursework in the failed or deferred element only. For referred candidates, the module mark will be capped at 50%. For deferred candidates, the module mark will be uncapped.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

Basic reading:

ELE: http://vle.exeter.ac.uk/â€¨â€¨

Web based and Electronic Resources:

Other Resources:

Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Strang, G.	Introduction to Linear Algebra	4th	Wellesley Cambridge	2005		[Library]
Set	Grus, J.	Data Science From Scratch: First Principles With Python		O'Reilly	2015		[Library]
Set	McKinney, W.	Python for Data Analysis: Data Wrangling with Pandas, Numpy and iPython	1st	O'Reilly Media	2012	978-1449319793	[Library]

CREDIT VALUE	15	**ECTS VALUE**	7.5
PRE-REQUISITE MODULES	None		
CO-REQUISITE MODULES	None		
NQF LEVEL (FHEQ)	7	**AVAILABLE AS DISTANCE LEARNING**	No
ORIGIN DATE	Tuesday 10 July 2018	**LAST REVISION DATE**	Wednesday 18 January 2023
KEY WORDS SEARCH	Statistics; Machine Learning; Linear Algebra; Probability; Python.		