Module Specification
CSCK544 – Maths and Statistics for Data Science and AI

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1.   Module Details

Module Title:	Maths and Statistics for Data Science and AI

Short Title:	Maths and Statistics for DS and AI

Module Code:	CSCK544

Marketing Module Synopsis:	Computer Science in general, and Data Science and AI, in particular, has its roots in Mathematics. This module is designed to furnish students from a non-technical background (a first degree in a subject other than computer science or closely related subject) with the necessary mathematical and statistical underpinning required to study Data Science and AI.

Credits:	15

Level:	Level 7

Delivery Location(s)	Online

Semester:	Whole Session

Academic Year:	2021-22

Faculty:	Faculty of Science and Engineering

School/Institute (Level 2):	School of Electrical Engineering, Electronics and Computer Science

Curriculum Board (level 1):	Computer Science PGT

Module Coordinator:	Frans Coenen

Other staff:	Helen Mattocks

External Examiner(s):	Neil Gordon, Dan Neagu

Pre-requisites:	N/A

Co-requisites:	N/A

Barred Combinations:	N/A

CE/CPD Provision:	No

Overview:	Computer Science in general, and Data Science and AI, in particular, has its roots in Mathematics. This module is designed to furnish students from a non-technical background (a first degree in a subject other than computer science or closely related subject) with the necessary mathematical and statistical underpinning required to study Data Science and AI.

Notes:	21/22 Modification is minor and needs no further scrutiny.20/21 Online module provided in collaboration with Kaplan Open Learning.

Maximum Places:	250

HESA Cost Centre(s):	MUST BE COMPLETED FOR APPROVAL

Status:	Approved

HECoS Subject	Proportion (%)
100366: Computer Science	100 %

The table below is automatically completed from programme data held in Curriculum Manager; during 2019/20 it is likely to have no data or incomplete data until all programme records are in Curriculum Manager.

In Programmes:	Programme Validation Status	Module Status:	Programme Stage / Group / / Sub-group
Data Science and Artificial Intelligence MSc 2021-22	Validated	Required	Online Flexible Learning Y1 Online Flexible Learning Y1 Required Module 2

The table below must be completed for module approval, including confirmation that there are zero costs to the student.

Student Cost(s)

Cost Type:	Description:	Value type (exact, approximate or max/min range):	Cost (exact or approximate):	Costs range:	
				Minimum Cost:	Maximum Cost:
Student Cost	Over the anticipated 8 week module period, an estimated average cost of £12.50 per week for internet access and contribution to the cost of a personal computer (global variations may apply).	Approximate	100.00		

2. Aims and Content

Educational Aims:

1. To provide students with a systematic understanding of the key mathematical and statistical concepts and techniques underpinning established mechanisms of Data Science and AI.2. To provide students with sufficient mathematical and statistical knowledge to understand the operation and deployment of key tools and techniques of Data Science and AI.3. To provide students with an appropriate level of knowledge to able to interpret the results generated when using the techniques of Data Science and AI.

Outline Syllabus:

Weeks 1 and 2:   Differential CalculusReview of basic calculus - numbers, sets and functions. Basic geometry, coordinate systems, lines and trigonometry. Limits, continuity, derivatives, velocity, concavity in differential calculus.Optimisation -minima/maxima, gradient descent and second order methods (Newton)   Weeks 3 and 4: Linear Algebra Basic concepts - vectors, matrices, dot products and matrix product. Geometry of matrices and derivatives, linear transformations and partial derivatives. Extensions - Eigen values and vectors, determinants. Linear basis and projections, Eigen-decomposition and SVD, pseudoinverse.Weeks 5 and 6: Probability TheoryBasic probability - events, sample space, frequentist vs Bayesian approach, law of large numbers, conditional probability, independence, Bayes theorem and random variables. Probability distributions - probability sampling, random sampling and sampling distributions.Weeks 7 and 8: StatisticsMeasures of centre and variation, statistical significance (confidence intervals) and hypothesis testing. Errors, chi-square independence test, Correlation vs causation. Descriptive statistic. Data presentation: scatter plots, line graphs, bar charts, histograms and box plots.

Reading lists and resources:

Type	Category	Title	Description

3. Module Outcomes (learning outcomes, skills and other attributes)

Ref No.	Learning Outcome / Skill:	Category:
M1	A systematic understanding of basic mathematical principles and methods of interest to Data Science and AI.	Learning Outcomes: Master's
M2	A critical awareness of basic and more specialised concepts in probability theory and statistics relevant to Data Science and AI.	Learning Outcomes: Master's
M3	An ability to undertake software projects in the domain of Data Science and AI.	Learning Outcomes: Master's
M4	An ability to communicate the outcomes of experimental work in the domain of Data Science and AI.	Learning Outcomes: Master's
S1	Communication skills in electronic as well as written form.	Skills
S2	Self-direction and originality in tackling and solving problems within the domain of Computer Science, and an ability to act autonomously in planning and implementing solutions in a professional manner.	Skills
S3	An ability to act autonomously and professionally when planning and implementing solutions to computer science problems.	Skills
S4	Experience of working in development teams, respecting others, co-operating, negotiating/persuading, awareness of interdependence with others.	Skills
S5	Group working, respecting others, co-operating, negotiating/persuading, awareness of interdependence with others	Skills

4. Assessments

Assessment Strategy:

The module features two broad categories of assessment: discussion questions and practical assessments. The first has a focus on moderated active learning, where the faculty member responsible for the module posts discussion questions to which students respond individually and then consider each other's responses. Each discussion question runs over a three-week period. At the end of the first week each student posts a 500 word "initial response". During the second week each student selects two or three responses, made by other students in the first week, and writes a 500 word "follow-up" response. In the third week each student reviews the initial and follow-up responses from the previous two weeks and submits a 500 word executive critical summary with respect to the main themes identified by the responses. Practical assessment adopts the principle of authentic assessment where the assessment tasks to be undertaken are aligned with the kinds of task that students would be expected to undertake in a professional setting.1. Due to nature of the on-line mode of instruction work is not marked anonymously. 2. Reassessment opportunities offered in line with Code of Practice on Assessment. 3. Penalties for late submission will be in line with Code of Practice on Assessment.

All fields in the table below must be completed for module approval.

Method	Description	Type	Units of Length	Length	Min	Max	Description (re length)	Weighting	Assessment period(s)	Group Work	Must Pass	Final Assessment
Practical assessment	Practical Assessment 2. Practical exercise directed at probability theory and statistics	Summative	Hours	12	N/A	N/A	N/A	30 %	Wk08	No	No	Yes
Practical assessment	Practical Assessment 1. Practical exercise directed at differential Calculus and linear algebra.	Summative	Hours	12	N/A	N/A	N/A	30 %	Wk05	No	No	No
Coursework	Discussion Question 2: Use the online discussion forum to critically discuss experiences and opinion within the cohort	Summative	Words	N/A	1000	1500	N/A	20 %	Wk07	No	No	No

Method	Description	Type	Units of Length	Length	Min	Max	Description (re length)	Weighting	Assessment period(s)	Group Work	Must Pass	Final Assessment
	relating to some aspect of maths and statistics in Data Science and AI .											
Coursework	Discussion Question 1: Use the online discussion forum to critically discuss experiences and opinion within the cohort relating to some aspect of maths and statistics in Data Science and AI .	Summative	Words	N/A	1000	1500	N/A	20 %	Wk03	No	No	No

Please see Appendix 1 for details of the outcomes tested by the above assessments.

Module Specification Appendix 1: Assessments and the Outcomes Tested

Module Title	Maths and Statistics for Data Science and AI
Module Code	CSCK544

In the table below, all fields should be completed for approval, except for the **Weighting** field for a **Formative Type** assessment method.

Assessment Method	Type	Pass / Fail	Weighting	Marked out of	Pass Mark	Learning Outcomes / Skills Tested
Practical assessment	Summative	No	30 %	100	50	
Practical assessment	Summative	No	30 %	100	50	

Assessment Method	Type	Pass / Fail	Weighting	Marked out of	Pass Mark	Learning Outcomes / Skills Tested
Coursework	Summative	No	20 %	100	50	
Coursework	Summative	No	20 %	20	50	

5. Learning and Teaching Methods

Summary of Learning and Teaching Methods:

The mode of delivery is by online learning, facilitated by a Virtual Learning Environment (VLE). This mode of study enables students to pursue modules via home study while continuing in employment. Module delivery involves the establishment of a virtual classroom in which a relatively small group of students (usually 10-25) work under the direction of a faculty member. Module delivery proceeds via a series of eight one-week online sessions, each of which comprises an online lecture, supported by other eLearning activities, posted electronically to a public folder in the virtual classroom. The mode of learning includes a range of required and optional eLearning activities, including but not limited to: lecture casts, live seminars, self-assessment opportunities, and required and suggested further reading and try-for-yourself activities. Communication within the virtual classroom is asynchronous, preserving the requirement that students are able to pursue the module in their own time, within the weekly time-frame of each online session. An important element of the module provision is active learning through collaborative, cohort-based, learning using discussion fora where the students engage in assessed discussions facilitated by the faculty member responsible for the module. This in turn encourages both confidence and global citizenship (given the international nature of the online student body).

The following table must be completed for module approval, accounting for all hours associated with the credit value of the module, e.g. for 15 credits there should be 150 hours of learning and teaching activity, including independent learning.

Learning and Teaching Method:	Length (Minutes):	Times per Week (if applicable):	Number of Weeks (if applicable):	Calculated Hours (if applicable):	Hours:
Self-Directed Learning	N/A	N/A	N/A	N/A	62
Assignment	N/A	N/A	N/A	N/A	40
E-lecture	N/A	N/A	N/A	N/A	24

Learning and Teaching Method:	Length (Minutes):	Times per Week (if applicable):	Number of Weeks (if applicable):	Calculated Hours (if applicable):	Hours:
Online Discussions	N/A	N/A	N/A	N/A	24

6. Supplementary Information

If a risk assessment is required for this module for students under 18, please record a summary of the risks:	N/A