Module Descriptor

Title	Data Mining and Visualisation		
Session	2025/26	**Status**	Published
Code	COMP11069	**SCQF Level**	11
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	Naeem Ramzan		

Summary of Module

This module covers the main analytical skills and tools a data scientist/analyst requires to extract useful information from data. It will build on the foundations on how to properly communicate this information to the relevant audience. Students will be progressively guided through the world of data analytics starting from an introduction to quantitative research methods and related techniques. The journey will take them to the world of machine learning and pattern recognition by presenting the key ideas in this area enabling informed decisions when applying these concepts to real-world problems. Additional key advanced concepts and research trends in the field will also be presented as well as the basic needed principles to communicate clearly and effectively the patterns found on the data. A special attention will thus be paid to data visualisation so that the students are able to answer research questions, inform their decisions, and convey results with data supported evidence.

This module has been specifically designed considering the UWS Graduate Attributes of Universal, Work ready, and Successful. Details to these attributes is available at UWS Graduate Attributes webpage.

Module Delivery Method	**On-Campus[1]** ☒	**Hybrid[2]** ☐	**Online[3]** ☐	**Work -Based Learning[4]** ☐
Campuses for Module Delivery	☐ Ayr ☐ Dumfries	☐ Lanarkshire ☐ London	☐ Online / Distance Learning ☐ Other (specify)	

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

			☒ Paisley			
Terms for Module Delivery	Term 1	☐	Term 2	☒	Term 3	☐
Long-thin Delivery over more than one Term	Term 1 – Term 2	☐	Term 2 – Term 3	☐	Term 3 – Term 1	☐

Learning Outcomes	
L1	Gain deep Knowledge and comprehensive understanding of the main methods and tools available for data analysis, including the underlying theoretical concepts.
L2	Apply and evaluate different data analysis methods and visualisation tools to real problems and make an informed decision on their suitability for specific situations.
L3	Design data analysis methodologies for specific problems including effective communication of main findings to relevant audiences, and critically appraise the results.
L4	N/A
L5	N/A

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	**During completion of this module, there will be an opportunity to achieve core skills in:**
Knowledge and Understanding (K and U)	**SCQF 11** Comprehensive knowledge and understanding of the main methods and tools employed for data analysis including the underlying theory and principles.
Practice: Applied Knowledge and Understanding	**SCQF 11** Apply a variety of data analysis methodologies to real situations and communicate the results using available visualisation tools. Gather relevant information from the data. Make informed decisions on the most suitable methods to analyse a specific dataset. Interpret results and communicate their findings using the appropriate visualisation technique.
Generic Cognitive skills	**SCQF 11** Critical knowledge of the state-of-the-art in data analysis. Identify most suitable methods/tools to make informed decisions in a real situation. Design a complete data analysis methodology and communicate findings in real problems.
Communication, ICT and Numeracy Skills	**SCQF 11** Effectively communicate the information extracted from data analysis using a variety of available tools, both from report writing and presentations. Critically appraise numerical results gathered from the analysed data.
Autonomy, Accountability and Working with Others	**SCQF 11** Initiative and autonomy working in lab assignments. Students will also work as part of a team in project assignments and must develop a sense of accountability to others.

Prerequisites	Module Code	Module Title
	Other	
Co-requisites	Module Code	Module Title

Learning and Teaching

In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.

The module will be delivered by means of lectures and supervised hands-on lab work. Lectures will cover the theoretical background and practical applicability in real life problems. Concepts will be introduced by posing a practical problem and working out the needed theoretical knowledge to solve them. The delivery will encourage student participation to ensure an active learning experience. Group discussions will be held to promote critical thinking and boost informed decisions on the suitability of different state-of-the-art methods. Lab exercises will help student develop their knowledge in incremental fashion using a learning-by-doing approach. This will support the development of knowledge and understanding of the topics. In addition, labs will develop their skills to carry out a full data analysis project and communicate the results, which will be part of the final assessment.

Indicative summary of the topics covered by this module:

Unit 1-Introduction

• Overview of module and topics covered

• Introduction to data analytics and data mining

• Definitions

• Data mining process and framework

Unit 2-Exploratory data analysis and visualisation

• Review of basic concepts of probability theory and random variables

• Descriptive statistics

• Visualising single variables

• Visualising multiple variables

• Dirty data

• Data exploration vs. presentation

Unit 3-Visualisation tools

• Libraries and toolboxes in data analysis packages

• Specific packages

• Libraries and APIs

• Module toolset

Unit 4-Basic analytics and preprocessing

• Statistical methods for evaluation

• Data sources and types of data

• Data sampling
• Missing data
• Outlier detection and handling
• Normalization
• Categorization

Unit 5-Data classification I
• Introduction to statistical pattern recognition
• Unsupervised vs. supervised classification
• Feature extraction and selection
• Principal component analysis
• Linear discriminant analysis
• Dimensionality reduction

Unit 6-Data classification II
• Classifier design
• Model evaluation and error estimation
• Decision trees
• Classifiers based on Bayes decision theory

Unit 7-Advanced data classification
• Classifiers based on decision boundaries
• Neural Networks
• Support Vector Machines
• Ensembles
• Clustering

Unit 8-Regression, correlation, and time series analysis
• Correlation analysis
• Linear regression
• Logistic regression
• Introduction to time series analysis

Unit 9 – Advanced data analytics
• Decision rules
• Analysis of textual data and social media
• Association rules
• Introduction to deep learning

Unit 10- Communication and data visualisation

• Tips on data presentation

• Representation methods

• Evolution of a graph

• Cleaning up a graphic

• Case studies and examples

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture / Core Content Delivery	20
Laboratory / Practical Demonstration / Workshop	20
Asynchronous Class Activity	50
Independent Study	106
Personal Development Plan	4
Please select	
TOTAL	200

Indicative Resources

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

[1] C. Long (ed.). Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services; John Wiley & Sons

[2] V. Kotu and B. Deshpande. Predictive Analytics and Data Mining. Concepts and Practice with RapidMiner. Morgan Kauffman

[3] Bart Baesens. Analystics in a Big Data World. The Essential Guide to Data Science and its Applications. John Wiley & Sons

[4] I. H. Witten and E. Frank. Data Mining. Practical Machine Learning Tools and Techniques: Morgan Kauffman

[5] S. Theodoridis and K. Koutrumbas. Pattern Recognition. Academic Press.

[6] B. Rosner. Fundamentals of Biostatistics. Cengage Learning.

Additional Resources can be found online and in scientific databases.

Software packages:

• Matlab with relevant toolboxes (Statistics and Machine Learning, Neural Networks, etc.)

• R with relevant packages (ggplot2, etc.)

(N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure, Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

For the purposes of this module, academic engagement equates to the following:

The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. You will scan your attendance via the scanners each time you are on-campus and you will login to the VLE several times per week. Where you are unable to attend a timetabled learning session due to illness or other circumstance, you should notify the Programme Leader that you cannot attend. Across the School an 80% attendance threshold is set. If you fall below this, you will be referred to the Student Success Team to see how we can best support your studies.

Equality and Diversity
The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. This module has lab-based teaching and as such you are advised to speak to the Module Co-ordinator to ensure that specialist assistive equipment, support provision and adjustment to assessment practice can be put in place, in accordance with the University's policies and regulations.
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	**Computing**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☐ **Yes** ☒ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Business & Applied Computing
Moderator	Keshav Dahal
External Examiner	R Menzies
Accreditation Details	
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.08

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1

Exam (40%). Students will be required to take a formal written on-campus exam. The exam will both contain theoretical and practical questions aiming at assessing the achievement of LO1 and LO2.
Assessment 2
Coursework(60%). Students will work in groups to develop a specific data analysis project over a selected dataset. Coursework will assess achievement of LO2 and LO3 by means of a written report justifying the selection of methods, detailing the analysis, and presenting the results. Lab implementations will also be submitted and the main findings presented to the class. Prior to this assessment, students lab work and progress will be assessed and formative feedback provided in the lab.
Assessment 3
(N.B. (i) Assessment Outcomes Grids for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An indicative schedule listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Unseen closed book exam	☒	☒	☐	☐	☐	40	2

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Dissertation/ Project report/ Thesis/Creative output/ Audiotapes/ Videotapes/ Games/ Simulations/Presentation	☐	☒	☒	☐	☐	60	2

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
	☐	☐	☐	☐	☐		
Combined total for all components						100%	4 hours

Change Control

What	**When**	**Who**
Attendance and Engagement, EDI and External Examiner updated	22/01/2025	A Adamson
