6 Module Documentation

M1 Programming for Data Analytics

6.1.1 Headline information about the module

Module title	Programming for Data Analytics
Module NFQ level (only if an NFQ level can be demonstrated)	9
Module number/reference	M1
Parent programme(s) the plural arises if there are embedded programmes to be validated.	MSc in Science in Data Analytics
Stage of parent programme	AWARD
Semester (semester1/semester2 if applicable)	1
Module credit units (FET/HET/ECTS)	ECTS
Module credit number of units	5
List the teaching and learning modes	Full time & Part time blended learning
Entry requirements (statement of knowledge, skill and competence)	See Section 4
Pre-requisite module titles	none
Co-requisite module titles	none
Is this a capstone module? (Yes or No)	No
Specification of the qualifications (academic, pedagogical and professional/occupational) and experience required of staff (staff includes workplace personnel who are responsible for learners such as apprentices, trainees and learners in clinical placements)	Academic and Professional: PhD desirable and a minimum of an MSc is required. However, in exceptional cases, NFQ Level 8 in Data Analytics, Computer Science, Software Development, Software Engineering or equivalent may be acceptable when combined with significant industrial experience. Pedagogical: Teaching experience is desired. Completion of postgraduate CPD/Certificate in Teaching and Learning or similar preferred. Experience in blended learning delivery required. In absence of experience, training will be mandatory and will be provided.
Maximum number of learners per centre (or instance of the module)	120
Duration of the module	1 semester
Average (over the duration of the module) of the contact hours per week (see * below)	2.5 Hours
Module-specific physical resources and support required per centre (or instance of the module)	Physical resource requirements are 1 laptop or PC/workstation per student. On campus and online resources as per programme specification.
Analysis of required learning effort	

*Effort while in contact with staff										
On campus Lecture / Classroom demonstrations		Mentoring and small-group tutoring		Other (Reflective development, directed reading/group work)		Online classes & Directed e-learning (hours)	Independent learning (hours)	Other hours (specify)	Work-based learning hours of learning effort	Total effort (hours)
Hours	Minimum ratio teacher/learner	Hours	Minimum ratio teacher/learner	Hours	Minimum ratio teacher/learner					
20	1:60	5	1:30	5	1:60	N/A	95	N/A	N/A	125
Allocation of marks (within the module)										
				Continuous assessment		Supervised project	Proctored practical examination	Proctored written examination	Total	
Percentage contribution				100%					100%	

6.1.2 Module aims and objectives

The aim of this module is to provide the learner with knowledge of:

1. Fundamental analytical programming concepts
2. Problem solving techniques applied in real world domains
3. Complex data manipulation operations
4. Optimising and improving concurrency in existing programs
5. Testing, quality control and maintenance

6.1.3 Minimum intended module learning outcomes

On successful completion of this module the learner will be able to:

1. Debate the selection of programming concepts in the design of programmatic solutions, in terms of paradigm and language selection. (Linked to PLO 1)
2. Design and implement algorithms for use within the context of data analysis. (Linked to PLO 2)
3. Critically appraise aggregation methods to process and manipulate data from multiple data structures. (Linked to PLO 3)

4. Formulate and evaluate a testing and optimisation strategy for programmatic solutions. (Linked to PLO 5)
5. Compare, contrast and select relevant libraries / techniques to process data from diverse sources. (Linked to PLO 5)

6.1.4 Rationale for inclusion of the module in the programme and its contribution to the overall IPLOs

This module aims to provide the learner with the core concepts and techniques of programming with an emphasis on problem solving in the context of data analysis. The core concepts and implementation techniques learned in this module will enable learners to apply knowledge from other modules in a practical way, thereby re-enforcing learning from all associated modules.
By incorporating basic programming skills in a hands-on practical integrated manner enables the learner's ability to program but also reinforces the inseparable nature of programming within the field of Data analytics. This integrated approach to practical programming skills is continued in accompanying modules.

6.1.5 Information provided to learners about the module

This module specification is replicated in the programme handbook and made available on Moodle.
This information is further supplemented by information given to learners at induction as an overview of the module.

6.1.6 Module content, organisation and structure

The following indicative syllabus contains a learner reflective component as outlined in the teaching and learning strategy for this programme.

Content
Analytical programming concepts • Programming languages for data analysis • Programming paradigms (imperative / declarative) • Concurrency (parallel / multi-threaded programming pros / cons / trade-offs)
Program design / Flow control • Declarative / control statements • Classes / objects • Iterative blocks / nested blocks • Functions / methods (arguments and return values) • Recursion • Exception handling
Data types and Structures • Basic data types • Collections (eg. Arrays, Tuples, Dictionaries and lists) • Character strings • Data frames • Multi-dimensional data structures (Accessing, manipulating and processing data)
Data Acquisition • Connecting to databases: (Create/Read/Update/Delete (CRUD) Operations.) • Data models and overview (SQL / NoSQL) • API implementation (eg. Social Media platforms, aggregated scientific data)

Algorithms and organisation

- Lambda functions
- Searching / sorting
- Pipeline using Analytical Packages and libraries
- Testing and optimisation strategies (eg. Unit testing, re-factoring)

Programming skills are continuously developed throughout this module through practical implementation of module content. Conceptual / theoretical topics will also be practically demonstrated through the use of appropriate tool sets, to emphasise the synergy between theory and programmatic demonstration.

Both theory and practice are demonstrated within the context of the module.

6.1.7 Module teaching and learning (including formative assessment) strategy

To provide the learner with a strong foundation in the core topics covered during the lectures, practical sessions will reinforce lecture content and provide supervised time to complete some assessment tasks. Sessions will be interactive, with instructor-led example exercises highlighting important topics discussed in lectures.

To provide formative assessment for this module the learner will:

- Be provided an opportunity at the beginning of each week to engage in group discussion on the material covered the previous week, thereby allowing reflection and ensuring their competency
- Complete student-suggested tasks in a peer learning environment to encourage collaboration and allow learners to self-evaluate their current knowledge while gaining new knowledge and insights (this strategy links directly to PLO 7, PLO 8)
- Join additional discussions covering any lab-based exercises which have been provided to the learner.

Online and on campus learning activities according to learning type.

Learning Type	Online activities	On campus activities
Knowledge Acquisition	• Pre-recorded presentations / demonstrations • Multi-media text-based materials • Videos • Guest speakers • Open ed resources	• Face to face lecturers • Practical Demonstrations
Collaboration	• Group projects • Discussion forums • Virtual classroom peer learning • Team virtual lab activities • Group presentations • Mentoring	• Group projects • Team based lab activities / practical workshops • Group presentations
Discussion	• Discussion forums (synchronous and asynchronous) • Zoom breakout room discussions • Online tutorials • Project supervision • Webinars (industry experts)	• Class discussion • Tutorials • Project supervision • Face to face lab / practical activities

	• Reflective activities	
Investigation	• Open ed resources • Lab observations • Project research • Information and data sourcing, analysis and evaluation • Flipped Learning	• Text / data sourcing and analysis
Practice	• Virtual lab • Simulations • Case studies • Analysis of data sets • Presentations • Online quizzes / MCQs	• Labs • Practical workshops • Group work
Production	• E-portfolio • Reflective journal • Assessment outputs • Quiz / MCQs • Case studies • GitHub records	• Exam • Case studies • Final Project • Student demonstration

6.1.8 Work-based learning and practice-placement

Not Applicable

6.1.9 E-learning

Collaborative blended learning strategies will be utilised for this module to ensure peer learning can be experienced not only through face-to-face traditional learning but also through online approaches. The online element will be achieved through a variety of interactive methods, including discussion forums, collaborative blogs and wikis, virtual labs and classrooms, group online supervision, interactive demonstrations and e-portfolios. This integrated learning approach ensures learning can be both reflective and collaborative while developing the efficacy of the individual student as the module progresses.

6.1.10 Module physical resource requirements

Physical resource requirements are 1 laptop or PC/workstation per student. On campus and online resources as per programme specification.

6.1.11 Reading lists and other information resources

Recommended

Amos D, Bader D, Jablonski J, Heisler F, 2012-21
Python Basics: A Practical Introduction to Python 3
Realpython .com [ISBN: 9781775093329 ISBN: 9781775093336]

Zelle, John M. and van Rossum, Guido, 2016, Python Programming - An Introduction to Computer Science, 3rd Revised edition

R Core Team, 2015, Introduction to R, Samurai Media Ltd [ISBN: 978-9881443632]

Thomas H. Cormen et al., 2009, Introduction to algorithms, MIT Press Cambridge, Mass. [ISBN: 978-0262033848]
Gareth James et al., 2017. An Introduction to Statistical Learning with Applications in R, Springer, Berlin, Germany [ISBN: 978-1461471370]

Additional
Roger Peng, 2016, Exploratory Data Analysis with R, Lulu Press, Morrisville, NC, USA [ISBN: 978-1365060069]

6.1.12 Module summative assessment strategy

Online and on campus formative assessment activities according to assessment type.

Assessment	Online Assessment	On Campus Assessment
Knowledge Acquisition	• Pre-recorded presentations / demonstrations	• Live presentations / demonstrations
Collaboration	• Group projects • Team virtual lab activities • Group pre-recorded presentations / demonstrations	• Team lab activities • Group presentations / demonstrations
Formative	• Discussion forums (asynchronous) • Project (individual & group) supervision • Reflective activities	• Project (individual & group) supervision
Investigation	• Theoretical and practical project research • Problem Based Learning	• Problem Based Learning
Practical	• Virtual lab • Analysis of data sets • Online quizzes / MCQs • Technical tasks (individual and group)	• Lab • Analysis of data sets • Technical tasks (individual and group)
Production	• Artefacts • Student code repository records	• Artefacts • Student code repository records

For indicative assessment schedule see appendix 8

Mapping of summative and formative assessment: MIMLO to MIPLO

	Module Learning Outcomes	Programme Learning Outcomes	

A ✓ indicates that the PLO has been formatively assessed as per the teaching and learning strategy for the programme	1	2	3	4	5	1	2	3	4	5	6	7	8	
Summative Assessment	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	

6.1.13 Sample assessment materials

See appendix 9