OTHM LEVEL 7 DIPLOMA IN DATA SCIENCE

Qualification Number: 610/2153/2

Specification | February 2023

TABLE OF CONTENTS

QUALIFICATION OBJECTIVES

The principal objective of the OTHM Level 7 Diploma in Data Science qualification is to develop the knowledge and skills and construct the means for extracting business-focused insights from data. This requires an understanding of how value and information flows in a business, and the ability to use that understanding to identify business opportunities.

Learners will become competent and reflective practitioners, related to their current role, and in preparation for more challenging roles in the future.

OTHM has developed a suite of Level 7 Diploma qualifications. The qualifications provide learners with industry-specific and practical skills, enabling them to successfully apply their knowledge in the workplace, enhance their career prospects and allow progression to further study.

Key features of OTHM Level 7 qualifications;

- A stimulating and challenging programme of study that will be both engaging and informative for learners.
- Learners can gain the essential subject knowledge needed to progress successfully into further study or the world of work.
- Refreshed content that is closely aligned with employer and higher education needs,
- Assessments that consider cognitive skills along with affective and applied skills.
- Learners will develop knowledge and academic study skills including active research skills, effective writing skills, analytical skills, creative problem-solving, decision-making, and digital literacy.

Upon successfully completing the OTHM Level 7 Diploma in Data Science learners will be able to;

- Develop a strong understanding of data science, including evaluation, structuring, and cleaning of data for analysis.
- Develop sufficient skill in the R, Python or alternative programming languages to use them to successfully carry out data analysis to an advanced level.
- Gain the mathematical and statistical knowledge and understanding required to carry out basic and advanced data analysis.
- Develop a comprehensive knowledge of classical data analytics, including statistical inference, predictive modelling, time series analysis and data reduction.
- Become familiar with and use the tools and techniques used in data visualisation.
- Become familiar with and apply common machine learning techniques to problems to uncover options and solutions for them.

QUALITY, STANDARDS AND RECOGNITIONS

OTHM Qualifications are approved and regulated by Ofqual (Office of Qualifications and Examinations Regulation). Visit the Register of Regulated Qualifications.

OTHM has progression arrangements with several UK universities that acknowledges the ability of learners after studying level 7 qualifications to be considered for advanced entry into corresponding Master's programmes.

REGULATORY INFORMATION

Qualification Title	OTHM Level 7 Diploma in Data Science
Qualification Ref. Number	610/2153/2
Regulation Start Date	8/2/2023
Operational Start Date	13/2/2023
Duration	1 Year
Total Credit Value	120 Credits
Total Qualification Time (TQT)	1200 Hours
Guided Leaning Hours (GLH)	480 Hours
Sector Subject Area (SSA)	15.3 - Business management
Overall Grading Type	Pass / Fail
Assessment Methods	Coursework
Language of Assessment	English

EQUIVALENCES

OTHM level 7 diplomas are located on the Regulated Qualifications Framework (RQF) and are recognised as being at the same level as Master's degrees. However, they are shorter (120 credits) qualifications which means learners will have to proceed to the dissertation stage (60 credits) with an appropriate university to achieve a full Master's qualification.

QUALIFICATION STRUCTURE

The OTHM Level 7 Diploma in Data Science consists of 6 mandatory units for a combined total of 120 credits, 1200 hours Total Qualification Time (TQT) and 480 Guided Learning Hours (GLH) for the completed qualification.

Unit Ref.	Mandatory units	Credits	GLH	TQT
F/650/5562	Data Science Foundations	20	80	200
H/650/5563	Probability and Statistics for Data Analysis	20	80	200
J/650/5564	Advanced Predictive Modelling	20	80	200
K/650/5565	Data Analysis and Visualisation	20	80	200
J/650/5573	Data Mining, Machine Learning and Artificial Intelligence	20	80	200
L/650/5566	Advanced Computing Research Methods	20	80	200

DEFINITIONS

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected to be required in order for a Learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.

Total Qualification Time is comprised of the following two elements –

a) the number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and

b) an estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by – but, unlike Guided Learning, not under the Immediate Guidance or Supervision of – a lecturer, supervisor, tutor or other appropriate provider of education or training.

(Ofqual 15/5775 September 2015)

Guided Learning Hours (GLH) is defined as the hours that a teacher, lecturer or other member of staff is available to provide immediate teaching support or supervision to a learner working towards a qualification.

Credit value is defined as being the number of credits that may be awarded to a Learner for the successful achievement of the learning outcomes of a unit. One credit is equal to 10 hours of TQT.

ENTRY REQUIREMENTS

For entry onto the OTHM Level 7 Diploma in Data Science qualification, learners must possess:

- An honours degree in related subject or UK level 6 diploma or an equivalent overseas qualification
- Mature learners with management experience (learners must check with the delivery centre regarding this experience prior to registering for the programme)
- Learner must be 21 years old or older at the beginning of the course

English requirements: If a learner is not from a majority English-speaking country must provide evidence of English language competency. For more information visit English Language Expectations page on our website www.othm.org.uk.

Alternative professional qualifications with at least three years' relevant work experience in the public service field may also be considered. This could be in roles in local or national government, or in non-governmental and inter-governmental organisations, the voluntary and charitable sector, and private sector roles which support or deliver public services.

PROGRESSION

The OTHM Level 7 Diploma in Data Science enables learners to progress into or within employment and/or continue their further study.

As this qualification is approved and regulated by Ofqual (Office of the Qualifications and Examinations Regulation), learners maybe eligible to progress to Master's top-up at many universities in the UK and overseas with advanced standing. For more information visit the University Progressions page on the OTHM website.

DELIVERY OF OTHM QUALIFICATIONS

OTHM do not specify the mode of delivery for its qualifications, therefore OTHM Centres are free to deliver this qualification using any mode of delivery that meets the needs of their Learners. However, OTHM Centres should consider the Learners' complete learning experience when designing the delivery of programmes.

OTHM Centres must ensure that the chosen mode of delivery does not unlawfully or unfairly discriminate, whether directly or indirectly, and that equality of opportunity is promoted. Where it is reasonable and practicable to do so, it will take steps to address identified inequalities or barriers that may arise.

Guided Learning Hours (GLH) which are listed in each unit gives the Centres the number of hours of teacher-supervised or direct study time likely to be required to teach that unit.

The qualification has been designed to take learners on a structured learning pathway. The sequencing of units is likely to encourage proactive engagement due to the nature of the subjects and topics therein, whilst also supporting learners to develop the learning and assessment skills required to be successful at level 7.

CENTRE RESOURCE REQUIREMENTS

Tutor / Assessor Requirements

- Tutors/Assessors must be appropriately qualified and occupationally competent in the areas in which they are training.
- They must hold a Level 6 qualification or equivalent
- They should hold or be working towards a Level 3 qualification in Assessing Vocationally Related Achievement such as the OTHM Level 3 Award in Assessing Vocationally Related Achievement.

Internal Verifier Requirements

- Internal quality assurers or verifiers must be appropriately qualified and occupationally competent in the areas in which they are moderating.
- They must hold or be working towards a Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practice and/or a Level 4 Certificate in Leading the Internal Quality Assurance of Assessment Processes and Practice such as the OTHM Level 4 Certificate in Leading the Internal Quality Assurance of Assessment Processes and Practice.

- They must demonstrate that they have undertaken Continued Professional Development (CPD) activities relating to occupational health and safety or auditing quality assurance to maintain and update their skills and knowledge within the last year.

OTHM will request to see copies of relevant qualifications from assessors and verifiers.

ASSESSMENT AND VERIFICATION

The units in this qualification are internally assessed by the centre and externally verified by OTHM. The qualifications are criterion referenced, based on the achievement of all the specified learning outcomes.

To achieve a 'pass' for a unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria. Judgement that the learners have successfully fulfilled the assessment criteria is made by the Assessor.

The Assessor should provide an audit trail showing how the judgement of the learners' overall achievement has been arrived at.

Specific assessment guidance and relevant marking criteria for each unit are made available in the Assignment Brief document. These are made available to centres immediately after registration of one or more learners.

OPPORTUNITIES FOR LEARNERS TO PASS

Centres are responsible for managing learners who have not achieved a Pass for the qualification having completed the assessment. However, OTHM expects at a minimum that centres must have in place a clear feedback mechanism to learners by which they can effectively retrain the learner in all the areas required before re-assessing the learner.

RECOGNITION OF PRIOR LEARNING AND ACHIEVEMENT

Recognition of Prior Learning (RPL) is a method of assessment that considers whether learners can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and do not need to develop through a course of learning.

RPL policies and procedures have been developed over time, which has led to the use of a number of terms to describe the process. Among the most common are:

- Accreditation of Prior Learning (APL)
- Accreditation of Prior Experiential Learning (APEL)
- Accreditation of Prior Achievement (APA)
- Accreditation of Prior Learning and Achievement (APLA).

All evidence must be evaluated with reference to the stipulated learning outcomes and assessment criteria against the respective unit(s). The assessor must be satisfied that the evidence produced by the learner meets the assessment standard established by the learning outcome and its related assessment criteria at that particular level.

Most often RPL will be used for units. It is not acceptable to claim for an entire qualification through RPL. Where evidence is assessed to be only sufficient to cover one or more learning outcomes, or to partly meet the need of a learning outcome, then additional assessment methods should be used to generate sufficient evidence to be able to award the learning outcome(s) for the whole unit. This may include a combination of units where applicable.

EQUALITY AND DIVERSITY

OTHM provides equality and diversity training to staff and consultants. This makes clear that staff and consultants must comply with the requirements of the Equality Act 2010, and all other related equality and diversity legislation, in relation to our qualifications.

We develop and revise our qualifications to avoid, where possible, any feature that might disadvantage learners because of their age, disability, gender, pregnancy or maternity, race, religion or belief, and sexual orientation.

If a specific qualification requires a feature that might disadvantage a particular group (e.g. a legal requirement regarding health and safety in the workplace), we will clarify this explicitly in the qualification specification.

UNIT SPECIFICATIONS

Data Science Foundations

Unit Reference Number	F/650/5562
Unit Title	Data Science Foundations
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

Data science combines powerful computing technology, sophisticated statistical methods, and expert domain knowledge to analyse and gain practical insights from huge amounts of data produced by organisations at present business environment. The aim of this unit is to introduce a range of data science concepts, data administration and governance and big data sources.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1.Understand the scope of Data Science and the roles of Data Scientists	1.1 Define the landscape of Data Science. 1.2 Evaluate key topics of Data Science. 1.3 Assess the role of a Data Scientist in comparison to other IT roles.	Data science comprising disciplines of; i) analytics, ii) statistics and iii) machine learning. The Data Science Program Topics include: • Introduction to Data Science • Mathematical and Statistical Skills

		• Machine Learning • Artificial Intelligence • Coding • Applied Mathematics and Informatics • Machine Learning Algorithms • Data Warehousing • Data Mining • Data Visualization • Cloud Computing • Data Structures • Scientific Computing • Scholastic Models • Project Deployment Tools • Predictive Analytics and Segmentation • Exploratory Data Analysis Data scientist roles include: • Sift and analyse data from multiple angles, looking for trends that highlight or unravel problems or opportunities. Use strong business acumen, as well as an ability to communicate findings and mine vast amounts of data for valuable and actionable insights. • Extract data from multiple sources. Analyse the data and produce insights. Use these insights to effectively influence how an organisation approaches business challenge. Use a combined knowledge of computer science and

		applications, modelling, statistics, analytics, and maths to solve problems. • Communicate important information and insights to business and IT leaders to enable superior decision making, operational excellence and business performance. Make data driven recommendations to business strategies to address dynamic business environment.
2.Understand Data Science core topics	2.1 Evaluate the potential impact of big data on both users and organisations when using big data for organisational decision making. 2.2 Critically analyse how Big Data is driving digital transformation. 2.3 Review different industry-leading tools and software solutions available for analysing and visualising data. 2.4 Evaluate how different industry-leading tools and software solutions are used to analyse and visualise data.	Big data: Explore common fundamental concepts, e.g., Doug Laney's Three Vs of Big Data (volume, velocity, and variety), an extension of Vs (variability, veracity, visualisation and value). Advantages of data-driven decision-making, e.g., continuous improvement and planning, collaborative decisions, reduce costs, real-time insights and new opportunities, digital literacy and data-driven cultures and challenges, e.g., inconsistent and unstandardised data, aligning decision making with business strategy, bias and discrimination, descriptive vs predictive trends and probabilities. Determine the value the digital transformation project will bring to the business, e.g., revenue, employee retention, increased productivity, creative performance, brand sentiment, customer satisfaction. Determine the value the digital transformation project will bring to the business, e.g., revenue, employee retention, increased

		productivity, creative performance, brand sentiment, customer satisfaction. Industry leading tools and software solutions to analyse data: e.g., SQL, MySQL, Node XL, Oracle Analytics, Qlik Analytics Platform, Google Fusion Tables, Open Refine, Python, R Programming, Apache Spark/Hadoop, SAS Sentiment Analysis, Microsoft Azure, AWS, MATLAB. Industry-leading tools and software solutions to visualise data: e.g., Microsoft Excel, Power BI and Azure, AWS, Oracle Visual Analyzer, Qlikview, Google Chart, Canvas, Tableau, SAS Visual Analytics. Building ethics into a data-driven culture and joining community of good practice, e.g., Data for Good Exchange (D4GX); Fairness, Accountability and Transparency in Machine Learning group (FAT/ML), Data Ethics Framework (gov.uk).
3.Understand Hadoop and Artificial Intelligence	3.1 Describe Apache Hadoop and its elements. 3.2 Analyse the advantages and disadvantages of using Artificial Intelligence in an area of application. 3.3 Investigate the technical implementation of an AI-based system.	Hadoop is used for storing, processing, retrieving, and pattern extraction from data across a wide range of formats like XML, Text, JSON, etc. SQL is used to store, process, retrieve, and pattern mine data stored in a relational database only. Appreciating the difference between AI and its subfields, e.g., Machine Learning, 4-bit deep learning and related interdisciplinary research

		areas such as robotics. How AI leverages other disciplines, e.g., computer science, mathematics, psychology, software engineering and linguistics. Understanding what defines Artificial/Machine Intelligence; philosophical debates around the ambitions of simulating human intelligence; and the phenomenon of the 'AI effect'. AI decision-making process,e.g. deep learning. Ethical use of AI, e.g., use of deep learning in recruiting new employees, deepfake.
4.Assess the role, responsibilities, and challenges for data scientists	4.1 Review the different strategies used by data specialists to ensure data compliance. 4.2 Explain the different roles, responsibilities and challenges faced by data specialists. 4.3 Analyse the role, responsibilities and challenges faced by data scientists when building ethics into a data-driven culture.	Data protection, informed consent, and privacy issues for compliance to include: Personally identifiable information protected health information, Protection Regulation (GDPR) rights and obligations, enforcement, and regulatory legal penalties. Data protection, informed consent and privacy issues for compliance to include; personally identifiable information, protected health information, General Data Protection Regulation (GDPR) rights and obligations, enforcement and regulatory legal penalties. Choice of industry-leading compliance management software and tools, e.g., Microsoft

		Compliance Manager, Amazon Web Services (AWS) Compliance, IBM DataOps.

Assessment

To achieve a 'pass' for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 4	All AC under LO 1 to 4	Report	3500 words

Indicative Reading List

Kotu, V., & Deshpande, B. (2019). *Data Science: Concepts and Practice*. Morgan Kaufmann Publishers, an imprint of Elsevier.

Probability and Statistics for Data Analysis

Unit Reference Number	H/650/5563
Unit Title	Probability and statistics for data analysis
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

The goal of this unit is to provide an overview of fundamental concepts in probability and statistics from first principles. This unit will introduce the core probability and statistical methods used in data science and a range of data analytic processes and techniques.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1.Develop understanding of distribution theory.	1.1 Explain probability distribution with examples. 1.2 Explain various types of probability distribution with examples. 1.3 Discuss Probability distribution fitting with examples.	Probability distribution-Bernoulli distribution, Binomial distribution, Normal distribution, Probability measure, Random variable, Bernoulli process, Markov chain, Observed value, Random walk, Stochastic process.

		Cumulative distribution function, Discrete probability distribution, absolutely continuous probability distribution Method of moments, Maximum spacing estimation, Method of L-moments, Maximum likelihood method
2.Develop understanding of classical inference.	2.1 Assess how Inferential statistical analysis is different from descriptive statistics. 2.2 Distinguish between three levels of modelling assumptions. 2.3 Discuss Frequentist inference with examples.	Inferential statistics- a point estimate, an interval estimate, a credible interval; Descriptive statistics- Univariate analysis, Bivariate and multivariate analysis Degree of models- Fully parametric, Semi-parametric, non-parametric p-value, Confidence interval, Null hypothesis significance testing
3.Develop understanding of Bayesian statistics.	3.1 Explain Bayes' theorem and its use in statistics. 3.2 Evaluate Bayesian experimental design with appropriate examples. 3.3 Discuss Markov Chain Monte Carlo (MCMC) methods and MCMC simulations with examples.	Bayesian inference, Statistical modelling Linear theory, Approximate normality, Posterior distribution Metropolis–Hastings algorithm, Slice sampling, Hamiltonian (or Hybrid) Monte Carlo (HMC)
4.Develop understanding of Linear modelling.	4.1 Discuss simple and multiple linear regression models with examples.	Simple linear regression, multivariable linear regression

	4.2 Discuss various Linear least squares methods with examples. 4.3 Critically evaluate how Linear regression models are used in AI/Machine learning.	Linear least squares methods: Ordinary least squares, weighted least squares, Generalized least squares. Cost Function, Gradient Descent, Forecasting, Predictions.

Assessment

To achieve a 'pass' for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 4	All AC under LO 1 to 4	Report	3500 words

Indicative Reading List

Kaptein, M., & den, H. E. van. (2022). *Statistics for data scientists: An introduction to probability, statistics, and data analysis*. Springer.

Advanced Predictive Modelling

Unit Reference Number	J/650/5564
Unit Title	Advanced Predictive Modelling
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

This unit will introduce you to some of the most widely used predictive modelling techniques and their core principles. Through this unit, you will form a solid foundation of predictive analytics, which refers to tools and techniques for building statistical or machine learning models to make predictions based on data. You will learn how to carry out exploratory data analysis to gain insights and prepare data for predictive modelling.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1.Develop models using binary logistic regression and assess their performance.	1.1 Evaluate and differentiate between various Binary Linear Regression models. 1.2 Develop Linear Regression models using a suitable software such as R, Python, or others.	Latent variable model, Probabilistic model Use programming/codes for the models. Probability distribution, Linear predictor, Link function

	1.3 Discuss generalized linear model and its usage. 1.4 Evaluate multinomial regression and its usage.	Ordered response and Unordered response.
2.Develop applications of multinomial logistic regression and ordinal logistic regression.	2.1 Evaluate the difference between multinomial and ordinal regression. 2.2 Discuss multinomial logistic regression with examples. 2.3 Discuss ordinal logistic regression with examples. 2.4 Develop models for nominal and ordinal scaled dependent variable in R or Python.	Multinomial and ordinal regression- intrinsic ordering Multinomial logistic regression- polytomous LR, multiclass LR, softmax regression, multinomial logit (mlogit), the maximum entropy (MaxEnt) classifier, and the conditional maximum entropy model. Ordinal regressions- ordered logit and ordered probit. Use R or Python coding to create models.
3.Develop generalised linear models and carry out survival analysis and proportional hazards regression.	3.1 Analyse the use of generalised linear models. 3.2 Apply the Poisson regression model and discuss overdispersion and zero inflation. 3.3. Model the ‘time to event’ variable using proportional hazards regression.	Generalised linear models: Probability distribution, Linear predictor, Link function. Maximum likelihood-based parameter estimation, Negative binomial, overdispersion and zero inflation Cox regression, Hazard and hazard-ratios, Survival, and cumulative hazard rates,

Assessment

To achieve a ‘pass’ for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 3	All AC under LO 1 to 3	Report	3500 words

Indicative Reading List

Kuhn, M., & Johnson, K. (2016). *Applied predictive modeling*. Springer.

Data Analysis and Visualisation

Unit Reference Number	K/650/5565
Unit Title	Data Analysis and Visualisation
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

This unit is essential for understanding the fundamentals of the data analysis process including gathering, cleaning, analysing and sharing data and communicating insights with the use of visualizations and dashboard tools. It is expected that students doing this unit will gain hands-on experience of implementing data analytic processes and techniques using a programming language such as Python, R, or a tool such as Weka, KNIME, PowerBI, Excel etc.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1. Critically evaluate the theoretical foundation of data analytics that determine decision-making processes.	1.1 Assess data analysis activities, techniques, and tools. 1.2 Evaluate the three types of data analytic methods and their use in industry.	Population, sampling, categorical data, nominal data, ordinal data, continuous data, discrete data. Regression analysis, Monte Carlo simulation, Factor analysis, Cohort analysis, Cluster analysis, Time series analysis, Sentiment analysis

	1.3 Demonstrate an ability to use a popular programming language or tool used in the data analytics industry to solve a problem.	Descriptive data analytics, predictive data analytics and prescriptive data analytics Variable identification, univariate and bi-variate analysis, missing values treatment, etc. through graphs, charts, plots.
2. Evaluate a range of predictive analytic techniques to discover new knowledge for forecasting future events	2.1 Compare a range of predictive analytical techniques for forecasting purposes with examples. 2.2 Evaluate how predictive analytic techniques can be used for forecasting purposes. 2.3 Apply an appropriate tool or programming language to demonstrate predictive analytic techniques.	Linear regression, multiple linear regression, and logistic regression. Qualitative, average approach, naïve approach, time series methods, causal relationship. Use R or Python for forecasting modelling.
3. Demonstrate prescriptive analytic methods for finding the best course of action for a situation	3.1 Evaluate prescriptive analytic techniques with appropriate examples. 3.2 Apply an appropriate programming language or tool to demonstrate how these prescriptive analytic techniques are used to find the best course of action in a situation.	Classical optimisation, linear programming techniques, nonlinear programming techniques, dynamic programming. Models, justifiable decisions, and defensible decisions.

Assessment

To achieve a ‘pass’ for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 3	All AC under LO 1 to 3	Report	3500 words

Indicative Reading List

Runkler, T. A. (2020). *Data analytics: Models and algorithms for Intelligent Data Analysis*. Springer Vieweg.

Data Mining, Machine Learning and Artificial Intelligence

Unit Reference Number	J/650/5573
Unit Title	Data Mining, Machine Learning and Artificial Intelligence
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

This unit is designed to introduce the science behind machine intelligence and the philosophical debate around the ambitions of simulating human intelligence to solve real-world problems. Students will be guided to appreciate AI types and applications and develop a better understanding of aspects related to intelligent agents. In this unit, students will master key concepts and gain the practical knowledge to apply machine learning principles to challenging real-world problems.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1. Understand the theoretical foundation of machine learning, Artificial Intelligence (AI)	1.1 Describe the fundamental aspects of machine learning and Artificial Intelligence. 1.2 Critically evaluate the types and areas of machine learning application to solve current real-world problems.	Appreciate the difference between AI and its subfields, e.g. Machine Learning, 4-bit deep learning and related interdisciplinary research areas such as robotics. How AI leverages other disciplines, e.g. computer science, mathematics, psychology,

	1.3 Differentiate between ANI, AGI and ASI. 1.3 Evaluate the advantages and disadvantages of using Artificial Intelligence in an application domain.	software engineering and linguistics. Recognising traditional problems (goals) of AI, Such as- reasoning, planning, learning, natural language processing and perception. Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), Artificial Super-intelligence (ASI). Business and e-commerce, e.g., chatbots, visual searches, intelligent virtual assistants. Engineering, e.g., Computer Aided Design (CAD), automation in factories. Healthcare, e.g., care of the elderly, heart beats analysis, computer-aided interpretation of medical images, drug discovery.
2. Understand the approaches, techniques and tools used to deploy intelligent systems	2.1 Evaluate the approaches, techniques, and tools for the deployment of modern intelligent systems. 2.2 Compare the advantages and challenges of several tools and techniques for the development of intelligent systems. 2.3 Evaluate the potential impact on both users and organisations of deploying several types, approaches and tools of AI, and intelligent systems.	Understanding Machine Learning algorithms and processes, including dataset preparation. Linear regression, logistic regression, decision tree, Support Vector Machine (SVM), Naïve Bayes, K-Nearest Neighbor(s) (KNN), k-means, gradient boosting. Options include but are not limited to TensorFlow, Torch, Theano, Azure Machine Learning, 4-bit deep learning, MathWorks, MATLAB (plus Simulink), CNTK (Computational Network Toolkit), Deeplearning4j, Scikit-Learn,

		Swift AI IBM for Watson, Keras, PyBrain, Google ML kit, Caffe, H20: open-source AI platform. Tools and required relationships for testing, e.g., accurate and clear documentation, role of static testing and review in early defect detection, the need to follow specific industry standards (e.g. GDPR, health informatics, safety critical) and psychology mindset of tester-developer relationship.
3.Understand technical aspects of AI based systems including modifications and ethical considerations	3.1 Explore the technical options to enhance the performance on an AI-based system. 3.2 Demonstrate and benchmark a technical modification to the existing deployment of an AI-based system to enhance its performance. 3.3 Evaluate the technical and ethical challenges, while appreciating the opportunities, of intelligent systems.	Statistical methods, computational intelligence, and traditional symbolic AI. Data collection, data sources and assessment of data reliability to modify AI-based system. Criteria for AI-based application selection, e.g., any application software, system or agent that exhibits intelligence as part of its problem-solving approach, e.g. open-source projects from Google and GitHub. The environmental footprint of AI, e.g., the carbon impact of AI. AI bias and the ethical dilemma, e.g., potential to widen socio-economic inequality, AI-powered hiring processes (employment opportunities), access to skilling, health/life extension, algorithmic quantitative trading.

Assessment

To achieve a ‘pass’ for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 3	All AC under LO 1 to 3	Report	3500 words

Indicative Reading List

Deisenroth, M. P., Faisal, A. A., & Ong, C. S. (2020). *Mathematics for Machine Learning*. Cambridge University Press.

Russell, S. J., & Norvig, P. (2022). *Artificial Intelligence: A modern approach*. Pearson.

Advanced Computing Research Methods

Unit Reference Number	L/650/5566
Unit Title	Advanced Computing Research Methods
Unit Level	7
Number of Credits	20
Total Qualification Time (TQT)	200 hours
Guided Learning Hours (GLH)	80 hours
Mandatory / Optional	Mandatory
Sector Subject Area (SSA)	15.3 - Business management
Unit Grading type	Pass / Fail

Unit Aims

The aim of this unit is to develop learners' ability to prepare for various types of academically based computing research through the development and design of a research proposal. Learners will develop a critical understanding of the philosophical, practical, and ethical concepts of research within the context of computing discipline.

Learning Outcomes, Assessment Criteria, and Indicative Content

Learning Outcomes – the learner will:	Assessment Criteria – the learner can:	Indicative content
1. Be able to evaluate research approaches in the computing discipline.	1.1 Appraise appropriate research problems in your chosen area. 1.2 Develop and justify appropriate research aims and objectives within a defined scope and timeframe.	Qualitative and quantitative approaches to Computing research The strengths and weaknesses of different approaches to public sector research. SMART objectives; terms of reference; rationale for selection, public sector confidence.

	1.3 Critically explore, select and justify research approaches. 1.4 Produce a SMART research plan using a suitable software.	GANTT chart, Key milestones, project goals
2. Be able to critically review literature on a relevant research topic.	2.1 Evaluate different literature sources to find most appropriate literature for the chosen research topic. 2.2 Critically analyse different theoretical approaches to the research problem.	Conceptualisation of the research problem or hypothesis. The importance of positioning a research project in context of existing knowledge. Significance and means of providing benchmarks by which data can be judged. Key theoretical frameworks for research. Advantages and limitations of qualitative and quantitative research approaches and methods
3. Be able to design research methodologies for a computing research problem	3.1 Critically evaluate relevant research methodologies to reflect the research objectives. 3.2 Design an appropriate methodology in terms of the research objectives for a defined population. 3.3 Justify the methodology selected in terms of the research objectives within agreed ethical guidelines. 3.4 Propose suitable techniques to use with quantitative and qualitative data collection and analysis.	Research methods e.g., survey, questionnaire, observations; ways to test sufficiency, reliability and validity; definitions of data e.g., primary and secondary sources, qualitative and quantitative; literature search and review – its credibility, use and acceptance; ways to reference sources. Size and sufficiency of data, reliability and validity of information gathered

4. Be able to develop a research proposal.	4.1 Create a research question, literature review and methodology. 4.2 Propose techniques for use with quantitative or qualitative data collection and analysis.	Report format e.g., title, acknowledgements, contents page, introduction, summary of literature review, research methods used, findings, recommendations, references, bibliography, appendices e.g., questionnaires, surveys. Referencing e.g., Harvard system

Assessment

To achieve a 'pass' for this unit, learners must provide evidence to demonstrate that they have fulfilled all the learning outcomes and meet the standards specified by all assessment criteria.

Learning Outcomes to be met	Assessment criteria to be covered	Type of assessment	Word count (approx. length)
All LO 1 to 4	All AC under LO 1 to 4	Report	3500 words

Indicative Reading List

Lauro, N. C. (2018). *Data Science and Social Research: Epistemology, methods, technology and applications*. Springer.

Additional Resources

Mastering Predictive Analytics with R - Second Edition James D. Miller, Rui Miguel Forte Publisher Packt Publication date: August 2017

IMPORTANT NOTE

Whilst we make every effort to keep the information contained in programme specification up to date, some changes to procedures, regulations, fees matter, timetables, etc may occur during the course of your studies. You should, therefore, recognise that this booklet serves only as a useful guide to your learning experience.

For updated information please visit our website www.othm.org.uk