

Qualifi Level 7 Diploma in Data Science

Specification (For Centres)

September 2020

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About QUALIFI

QUALIFI provides academic and vocational qualifications that are globally recognised. QUALIFI's commitment to the creation and awarding of respected qualifications has a rigorous focus on high standards and consistency, beginning with recognition as an Awarding Organisation (AO) in the UK. QUALIFI is approved and regulated by Ofqual (in full). Our Ofqual reference number is RN5160. Ofqual is responsible for maintaining standards and confidence in a wide range of vocational qualifications.

As an Ofqual-recognised Awarding Organisation, QUALIFI has a duty of care to implement quality assurance processes. This is to ensure that centres approved for the delivery and assessment of QUALIFI's qualifications and awards meet the required standards. This also safeguards the outcome of assessments and meets national regulatory requirements.

QUALIFI's qualifications are developed to be accessible to all learners in that they are available to anyone who is capable of attaining the required standard. QUALIFI promotes equality and diversity across aspects of the qualification process and centres are required to implement the same standards of equal opportunities and ensure learners are free from any barriers that may restrict access and progression.

QUALIFI's policy document for learners with specific requirements or who need special consideration is available for centre reference. Centres are responsible for reviewing the applicant's ability to complete the training programme successfully and ultimately achieve a qualification. The initial assessment by the centre will need to take into account the support that is readily available or can be made available to meet individual needs as appropriate. The centre must also consider prior learning and qualifications and they must be in a position to make a judgement on the learner's entry requirements.

Supporting Diversity

QUALIFI and its partners recognise and value individual difference and have a public duty to promote equality and remove discrimination in relation to race, gender, disability, religion or belief, sexual orientation and age.

Learner Voice

Learners can play an important part in improving the quality of this course through the feedback they give. In addition to the ongoing discussion with the course team throughout the year, there are a range of mechanisms for learners to feed back about their experience of teaching and learning. This can include questionnaires and surveys to allow both centres and QUALIFI to understand how we can improve the learner experience.

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1 Introduction

1.1 Why Choose QUALIFI Qualifications?

QUALIFI qualifications look to provide a realistic and broad opportunity for learners seeking career and professional development. They will support learners in realising their potential and provide clear objectives.

These objectives are to:

- provide career path support to learners who wish to develop their management skills, enterprise capabilities and opportunities in their chosen sector
- improve learner understanding of any given business environment and organisations and how they are managed and developed
- develop skills and abilities in learners to support their professional development.

Our qualifications provide a rich mix of disciplines and skills development opportunities. Learners will gain insight into the functioning, objectives and processes of organisations, appreciating their diversity and the influences and impact of external forces on them. The fast-changing and complex business environment and different organisational ability to stay resilient and respond positively to change and opportunities will be explored.

Our qualifications will develop learners' ability to:

- apply analytical and evaluative techniques and to enhance those skills
- investigate issues and opportunities
- develop their awareness and appreciation of managerial, organisational and environmental issues
- use management techniques and practices in imaginative ways
- make use of relevant information from different sources
- develop and encourage problem solving and creativity to tackle problems and challenges
- exercise judgement and take responsibility for decisions and actions
- develop the ability to recognise and reflect on personal learning and improve their personal, social and other transferable skills.

1.2 Employer Support for the Qualification Development

The development of this qualification has been initiated and guided by discussions and idea sharing with a range of employers, providers and existing centres demonstrating the rigor, validity and demand for the qualifications.

Discussions and feedback have been taken throughout the development of the qualification on content, the potential learner audience for the qualification and assessment methods, ensuring a valuable experience and a recognised set of skills, knowledge and understanding is realised.

1.3 Qualification Titles and Codes

This qualification has been accredited to the Regulated Qualification Framework (RQF) and has its own unique Qualification Accreditation Number (QAN). This number will appear on the learner's final certification document. Each unit within the qualification has its own RQF code. The QAN for this qualification is:

Qualifi Level 7 Diploma in Data Science - 603/6693/X

1.4 Awarding Organisation

QUALIFI LTD

2 Qualification Purpose, Rational, Aims Outcomes

2.1 Qualification Purpose

With the emergence of cloud computing, big data and artificial intelligence, data science has become a key fourth generation profession. The Level 7 Postgraduate Diploma in Data Science has been developed to prepare aspiring Data Scientists, Data Analysts and Artificial Intelligence specialists to take advantage of the growing business and employment opportunities in these fields.

The Diploma is designed to enable learners to gain skills in maths, statistics and programming in R, Python and SQL. The Diploma also provides a sound basis for a progression to Masters Degrees in a number of relevant disciplines.

We hope that centres and learners take the opportunity to learn a great deal from this programme that will provide relevant new skills and knowledge. It is envisaged that this programme will encourage both academic and professional development so that learners move forward to realise not just their own potential but also that of organisations across multiple sectors and industries.

2.2 Rationale for the Diploma

The rationale of the qualification is to provide a career path for learners who wish to develop their academic and practitioner research and critical thinking capabilities within the field of data science and analytics. The expected outcome of the Diploma, which is the achievement of a recognised UK qualification, is for learners to develop the skills required by organisations across multiple industries and sectors globally. This qualification will:

- prepare learners for employment; and
- support a range of roles in the workplace.

This qualification is suitable for part-time learners in the workplace but is equally appropriate for full-time learners who can also participate in formal work placements or part-time employment. Learners can progress

into or within employment in a wide range of industries and sectors that require the skills and knowledge of data scientists.

2.3 Overall Aims of the Diploma

The Level 7 Diploma in Data Science has been developed to enable learners to formulate research hypotheses, organise analyse and visualise data to uncover hidden solutions that can challenge traditional business assumptions and support organisations and their managers in key decision making through the application of a wide range of techniques and models used in data science.

The Qualifi Level 7 Diploma in Data Science aims to give learners the opportunity to:

- 1. Gain a recognised qualification from an internationally recognised awarding organisation.
- 2. Learn from a curriculum supported by the most recent content relevant to a contemporary business environment.
- 3. Develop new skills and knowledge that can be applied immediately and in the field of data science and analytics.
- 4. Have assessments marked and moderated by respected academic and practitioner professionals with practical experience in data science and analytics.
- 5. Progress along a pathway to gain a Masters degree or beyond.

2.4 Learning Outcomes

The overall learning outcomes of the Postgraduate Diploma in Data Science are to:

- 1. Gain the mathematical and statistical knowledge and understanding required to carry out basic and advanced data analysis.
- 2. Develop sufficient skill in the R, Python and SQL programming languages to use them to successfully carry out data analysis to an advanced level.
- 3. Develop a strong understanding of data management, including evaluation, structuring and cleaning of data for analysis.
- 4. Become familiar with and use the tools and techniques used in data visualisation
- 5. Develop a comprehensive knowledge of classical data analytics, including statistical inference, predictive modelling, time series analysis and data reduction.
- 6. Become familiar with and apply common machine learning techniques to business and other problems in order to uncover options and solutions for them.
- 7. Develop an understanding of essential concepts from contemporary themes in business.
- 8. Understand, evaluate and apply data science and analytics within business and organisational contexts.

These are the overall learning outcomes in line with a level 7 qualification. The learning outcomes for each of the units are identified in Appendix 1 within the descriptors.

3. Delivering the Qualifications

3.1 Quality Assurance Arrangements

All centres go through an approval process to be recognised as an approved centre. Centres must have in place qualified and experienced tutors. The experience of tutors and their ability to support learners will be important. Centres must commit to working with QUALIFI and its team of Quality Reviewers/External Verifiers. Continuing professional development (CPD) for tutors is also required.

Approved centres will be monitored by QUALIFI External Quality Reviewers (EQAs) to ensure that learners are provided with appropriate learning opportunities and guidance. EQAs will ask to see and discuss a centre's assessment plans. The suitability of these plans will be agreed with the centre.

QUALIFI's guidance on invigilation, preventing plagiarism and collusion will apply to centres.

Trainer Requirements

- Trainers must be appropriately qualified and occupationally competent in the areas in which they are training.
- They must hold a Level 7 qualification or higher in a data science related subject.
- They must hold a further qualification specifically in data science and analytics.

Assessor/Examiner Requirements

- Assessors must be appropriately qualified and occupationally competent in the areas in which they are assessing.
- They must have a minimum of 5 years' experience in data science and analytics.
- They must hold a Level 7 qualification or higher in a data science related subject.
- They must hold a Level 3 Award in Education and Training or equivalent.

Internal Verifier/Moderator Requirements

- Internal Verifiers must be appropriately qualified and occupationally competent in the areas in which they are moderating. They must have a minimum of 4 years' experience in data science and analytics for which they will be verifying internally
- They must hold or be working towards a Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practice and/or 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 data science and analytics to maintain and update their skills and knowledge within the last year.

3.2 Access to Study

All learners should be invited to an induction event to be introduced to the programme in detail through presentations and discussions with tutors and the centre support team.

All learners should be issued with the Diploma handbook, a timetable and meet with their personal tutor and fellow learners. Centres should assess learners carefully to ensure that they take the right qualification and the right pathways or optional units, to allow them to progress to the next stage.

Centres should check the qualification structures and unit combinations carefully when advising learners. Centres will need to ensure that learners have access to a full range of information, advice and guidance in order to support them in making the necessary qualification and unit choices. When learners are recruited, centres need to give them accurate information on the title and focus of the qualification for which they are studying.

All learners must be registered with QUALIFI within 30 days of centre registration.

3.3 Entry Criteria

The qualification has been designed to be accessible without artificial barriers that restrict access and progression. Entry to the qualifications will be through centre interview and learners will be expected to hold the following:

- A minimum of a Level 6 qualification in a related sector or;
- Bachelors degree or;
- A minimum of 3 years' work experience which demonstrates current and relevant industry knowledge.

In certain circumstances, individuals with considerable experience but no formal qualifications may be considered, subject to interview and being able to demonstrate their ability to cope with the demands of the programme.

4 Structure of the Qualification

4.1 Units, Credits and Total Qualification Time (TQT)

The QUALIFI Postgraduate Diploma Data Science is a Level 7 qualification with 9 mandatory units, 120 credits and 1200 TQT.

These units have been designed from a learning time perspective and are expressed in terms of Total Qualification Time (TQT). TQT is an estimate of the total amount of time that could reasonably be expected to be required for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a Qualification. TQT includes undertaking each of the activities of Guided Learning, Directed Learning and Invigilated Assessment.

Examples of activities which can contribute to Total Qualification Time include:

- guided learning
- independent and unsupervised research/learning
- unsupervised compilation of a portfolio of work experience
- unsupervised e-learning
- unsupervised e-assessment
- unsupervised coursework
- watching a pre-recorded podcast or webinar
- unsupervised work-based learning.

Guided Learning Hours (GLH) are defined as the time when a tutor is present to give specific guidance towards the learning aim being studied on a programme. This definition includes lectures, tutorials and supervised study in, for example, open learning centres and learning workshops. Guided Learning includes any supervised assessment activity; this includes invigilated examination and observed assessment and observed work-based practice.

Some examples of activities which can contribute to Guided Learning include:

- classroom-based learning supervised by a tutor
- work-based learning supervised by a tutor
- live webinar or telephone tutorial with a tutor in real time
- e-learning supervised by a tutor in real time
- all forms of assessment which take place under the immediate guidance or supervision of a tutor or other appropriate provider of education or training, including where the assessment is competence-based and may be turned into a learning opportunity.

4.2 Qualification Structure

The **Qualifi Level 7 Diploma in Data Science** comprises nine units in total. All units are mandatory, and all units cover a number of topics relating to learning outcomes.

Unit Reference	Mandatory Units	Level	TQT	Credits	GLH
J/618/4970	Exploratory Data Analysis	7	80	8	50
L/618/4971	Statistical Inference	7	120	12	70
R/618/4972	Fundamentals of Predictive Modelling	7	150	15	90
Y/618/4973	Advanced Predictive Modelling	7	150	15	90
D/618/4974	Time Series Analysis	7	150	15	90
H/618/4975	Unsupervised Multivariate Methods	7	150	15	90
K/618/4976	Machine Learning	7	150	15	90

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Unit Reference	Mandatory Units	Level	TQT	Credits	GLH
M/618/4977	Further Topics in Data Science	7	150	15	90
T/618/4978	Contemporary Themes in Business Strategy	7	100	10	60

4.3 Progression and Links to other QUALIFI Programmes

Learners completing the QUALIFI Level 7 Diploma in Data Science can progress to:

- a QUALIFI Level 7 and/or 8 Diploma,
- directly into employment in an associated profession,
- an appropriate dissertation only for a Master's Degree at one of our University partnerships.

4.4 Recognition of Prior Learning

Recognition of Prior Learning (RPL) is a method of assessment (leading to the award of credit) 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 so do not need to develop through a course of learning.

QUALIFI encourages centres to recognise learners' previous achievements and experiences whether at work, home or at leisure, as well as in the classroom. RPL provides a route for the recognition of the achievements resulting from continuous learning. RPL enables recognition of achievement from a range of activities using any valid assessment methodology. Provided that the assessment requirements of a given unit or qualification have been met, the use of RPL is acceptable for accrediting a unit, units or a whole qualification.

Evidence of learning must be valid and reliable. For full guidance on RPL, please refer to QUALIFI's policy document on RPL.

5 Guidance to Teaching and Learning

To ensure consistency and quality of delivery amongst centres, QUALIFI has outlined a number of policies and procedures required to ensure the very best standards are available to learners. These include:

- expertise of staff
- learning and teaching methods
- study skills
- learning resources
- personal development planning
- career opportunities.

The policies and procedures are available on request to all accredited centres or to those wishing to apply for accreditation to deliver QUALIFI qualifications.

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6 Learner Support

Centres should continue to support learners and encourage appropriate behaviour. To ensure consistency and quality of delivery amongst centres, QUALIFI has outlined a number of policies and procedures to ensure the very best standards are available to learners. These include:

- learners with disabilities
- health and safety
- conduct
- progression
- weekly timetable/attendance requirements.

The policies and procedures are available on request to all accredited centres or to those wishing to apply for accreditation to deliver QUALIFI qualifications.

6.1 Data Protection

All personal information obtained from learners and other sources in connection with studies will be held securely and will be used during the course and after they leave the course for a variety of purposes. These should be all explained during the enrolment process at the commencement of learner studies. If learners or centres would like a more detailed explanation of the partner and QUALIFI policies on the use and disclosure of personal information, please contact QUALIFI via email support@QUALIFI-international.com

7. Assessment

This qualification is vocational as can support a learner's career progression. To meet QUALIFI's aim to provide an appropriate assessment method, each unit will be assessed through tasks that will be written in a way to make them realistic 'work-related' tasks wherever possible. Learners will need to demonstrate their knowledge, understanding, original thought, problem-solving and recommendations on actions will also be asked for where appropriate. Intellectual rigour will be expected that is appropriate to the level of the qualification.

Assignments will contain a question strand for each of the given unit's learning outcomes. The assignment tasks will address the LO (learning outcome) and AC (assessment criteria) requirements. Within assignments, there will always be requirements for learners to engage with important and relevant theory that underpins the subject area.

The assignment questions will require learners to draw on real organisations to illustrate their answers. Mature and part-time learners will ideally be able to draw on their personal work experience too.

Sample assessments and marking schemes are available on request as part of the Qualification Specification supplied to centres.

For further information, please contact Qualifi.

8. Course Regulations

8.1 Course Requirements

Learners must complete all units and pass the appropriate mark to receive the full Diploma.

QUALIFI will issue certificates to all successful learners through the registered centres.

8.2 Classification of Awards

This qualification is pass/fail.

Decisions about the overall achievements of awards are made by QUALIFI through the application of the academic and relevant course regulations. It is based on the Average Percentage Mark (APM) or, at the discretion of QUALIFI, on the basis of learners' overall profile and performance subject to the minimum requirements.

8.3. Learner Voice

Learners can play an important part in improving the quality of this course through the feedback they give. In addition to the ongoing discussion with the course team throughout the year, there is a range of mechanisms for learners to feed back about their experience of teaching and learning.

8.4 Complaints

QUALIFI recognises that there may be occasions when learners and centres have cause for complaint about the service received. When this happens, the complaints procedure is intended to provide an accessible, fair and straightforward system that ensures as an effective, prompt and appropriate response as possible.

For more information on our formal complaints procedure please contact in the first instance or email: support@QUALIFI-international.com

9 Equality and Diversity

QUALIFI recognises that discrimination and victimisation are unacceptable and that it is in the interests of QUALIFI employees to utilise the skills of the total workforce. It is our aim to ensure that no employee or other representative of QUALIFI receives less favourable facilities or treatment (either directly or indirectly) in recruitment or employment on grounds of age, disability, gender/gender reassignment, marriage/civil partnership, pregnancy/maternity, race, religion or belief, sex, or sexual orientation (protected characteristics).

Our aim is that our workforce will be truly representative of all sections of society and each employee feels respected and able to give their best. We oppose all forms of unlawful and unfair discrimination or victimisation. To that end the purpose of this policy is to provide equality and fairness for all.

Our staff will not discriminate directly or indirectly, or harass customers or clients because of age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex, and sexual orientation in the provision of QUALIFI's goods or services.

This policy and the associated arrangements shall operate in accordance with statutory requirements, particularly the Equality Act 2010 <u>https://www.gov.uk/equality-act-2010-guidance</u>. In addition, full account will be taken of any guidance or codes of practice issued by the Equality and Human Rights Commission, any government departments, and any other statutory bodies.

The policy document will be monitored and reviewed annually and can be downloaded from our website or by making contact with QUALIFI.

10. Further Professional Development and Training

QUALIFI supports UK and international customers with training related to our qualifications. This support is available through a choice of training options offered through publications or through customised training at your centre.

The support we offer focuses on a range of issues including:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing learner-centred learning and teaching approaches
- building in effective and efficient quality assurance systems.

You can request customised training through your registered centre in the first instance. If you need to contact QUALIFI directly:

Our customer service number: +44 (0) 115 888 2323

Or email: support@QUALIFI-international.com

Website: www.QUALIFI.net www.QUALIFI-international.com

Appendix 1: Unit Descriptors

QUALIFI Level 7 Diploma in Data Science

Unit DS01: Exploratory Data Analysis

Unit code: J/618/4970

RQF level: 7

Aim

This unit provides learners with an in-depth understanding of R and Python programming and the fundamentals of statistics. This includes writing R and Python commands for data management and basic statistical analysis. The unit will help the learner to understand and perform descriptive statistics and present the data using appropriate graphs/diagrams and serves as a foundation for advanced analytics. Most industry analysis starts with Exploratory Data Analysis and a thorough study of this will help learners to perform data health checks and provide initial business insights.

Learning Outcomes. When awarded credit for this	Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
1. Handle and manage multiple datasets within R and Python environments.	1.1 Work smoothly in R and Python development environments.
	1.3 Import and export data sets and create data frames within R and Python in accordance with instructions.
	1.4 Sort, merge, aggregate and append data sets in accordance with instructions.
2. Use measures of central tendency to summarize	2.1 Differentiate between variable types and measurement
data and assess both the symmetry and variation in the data.	scales.
	2.2 Calculate the most appropriate (mean, median or mode
	etc.) measure of central tendency based on variable type.
	2.3 Compare variation in two datasets using the coefficient of variation.
	2.4 Assess symmetry of data using measures of skewness.

3. Present and summarise distributions of data	3.1 Select the most appropriate graph to present the data.
graphically.	3.2 Assess distribution using Box-Plot and Histogram.
	3.3 Visualize bivariate relationships using scatter-plots.
	3.4 Present time-series data using motion charts.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 3 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

The postgraduate diploma in data science is delivered online through our Canvas learning management system, supported by the use of online collaborative tools such as Zoom and Slack for live group online sessions, one-to-one mentoring and group messaging. Learners are provided with highly structured and detailed course content, broken down into nine distinct units covering core skills and knowledge. This includes recorded video presentations, comprehensive lecture slides, sample code for practice, quizzes and regular practice assignments. In addition, learners participate in regular scheduled online group sessions and have the opportunity to interact with mentors throughout the course.

Indicative Content

The content in this unit will enable the students to acquire the skills and knowledge to reach it's learning outcomes and successfully complete the prescribed assessments.

Content includes:

- Learning UI about basics rule of programming in both R and Python
- Create and import external datasets in R and python
- Export R data frames into external flat files
- Data Management in R and Python (Sort, merge, aggregate and subset)
- Introduction to basic concepts of Statistics, such as measures of central tendency, variation, skewness,

kurtosis

- Frequency tables crosstabs and bivariate correlation analysis
- Data visualization: what and why? Grammar of graphics, handling data for visualization
- Commonly used charts and graphs using ggplot2 package in R and matplotlib in python
- Advanced graphics in R and Python Data Management in R and Python (Sort, merge, aggregate and subset)
- Data Management in R and Python (Sort, merge, aggregate and subset)

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Exploratory Data Analysis with R Radhika Datar, Harish Garg Publisher: Packt Publishing (31 May 2019) ISBN: 178980437X

Exploratory Data Analysis in Python Suresh Kumar Mukhiya Publisher: Packt Publishing (27 Mar. 2020) ISBN-10: 1789537258, ISBN-13: 978-1789537253

Unit DS02: Statistical Inference

Unit code: L/618/4971

RQF level: 7

Aim

This unit provides learners with an in-depth understanding of statistical distribution and hypothesis testing. Statistical distributions include Binomial, Poisson, Normal, Log Normal, Exponential, t, F and Chi Square. Parametric and non-parametric tests used in research problems are covered in this unit. The unit will help learners to formulate research hypotheses, select appropriate tests of hypothesis, write mainly R programs to perform hypothesis testing and to draw inferences using the output generated. Learners will also study planned experiments as part of the unit.

earning Outcomes and Assessment Criteria	
earning Outcomes. When awarded credit for this	Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
L Evaluate standard discrete and standard continuous distributions.	1.1 Analyse the statistical distribution of a discrete random variable.
	1.2 Calculate probabilities using R for Binomial and Poisson Distribution.
	1.3 Fit Binomial and Poisson distributions to observed data
	1.4 Evaluate the properties of Normal and Log Normal distributions.
	1.5 Calculate probabilities using R for normal and Log normal distributions.
	1.6 Fit normal, Log normal and exponential distributions to observed data.
	1.7 Evaluate the concept of sampling distribution (t, F and Chi Square).
 Formulate research hypotheses and perform hypothesis testing. 	2.1 Write R and Python programmes that evaluate appropriate hypothesis tests
	2.2 Draw statistical inference using output in R
	2.3 Translate research problems into statistical hypotheses
	2.4 Assess the most appropriate statistical test for a hypothesis

L

3. Analyse the concept of variance (ANOVA) and an select an appropriate ANOVA or ANCOVA	3.1 Define variable, factor and level for a given research problem.
model.	3.2 Evaluate the sources of variation, explained variation and unexplained variation.
	3.3 Define a linear model for ANOVA/ANCOVA.
	3.4 Confirm the validity of assumption based on definitions and analysis of variation.
	3.5 Perform analysis using R and Python programs to confirm validity of assumptions.
	3.6 Draw inferences from statistical analysis of the research problem.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 2 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

The postgraduate diploma in data science is delivered online through our Canvas learning management system, supported by the use of online collaborative tools such as Zoom and Slack for live group online sessions, one-to-one mentoring and group messaging. Learners are provided with highly structured and detailed course content, broken down into nine distinct units covering core skills and knowledge. This includes recorded video presentations, comprehensive lecture slides, sample code for practice, quizzes and regular practice assignments. In addition, learners participate in regular scheduled online group sessions and have the opportunity to interact with mentors throughout the course.

Indicative Content

In this unit learners will study models, concepts and techniques that are used in distribution theory, parametric & non-parametric hypothesis testing and statistical analysis enabling them to formulate research hypotheses, select appropriate tests of hypothesis. and draw inferences using the output generated from R and Python code.

Content includes:

- Concept of random variables and statistical distribution
- Discrete vs. Continuous Random Variables

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- Standard discrete distributions-Bernoulli, Binomial and Poisson
- Using R to calculate probabilities
- Fitting of discrete distributions to observed data
- Standard continuous distributions-Normal, Log Normal, Exponential
- Introduction to sampling distributions
- Statistical Hypothesis Testing-concepts and terminology
- Parameter, test statistics, level of significance, power, critical region
- Parametric vs. non-Parametric Tests
- t tests (one sample, independent samples, paired sample)
- F test for equality of variance
- Z tests for proportions (single and independent samples)
- Non-parametric tests (Mann-Whitney U, Wilcoxon's signed rank)
- Tests for Normality, Q-Q plot
- What is analysis of variance?
- Definitions: Variable, factor, levels
- One Way Analysis of Variance
- Two Way Analysis of Variance (including interaction effects)
- Multi Way Analysis of Variance
- Analysis of Covariance
- Kruskal-Wallis Test
- Friedman Test

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Publisher: Packt Open Textbook Library Statistical Inference For Everyone Copyright Year: 2017 Brian Blais, Bryant University

Unit DS03: Fundamentals of Predictive Modelling

Unit code: R/618/4972

RQF level: 7

Aim

This unit provides a strong foundation for predictive modelling. Its objective is to define the entire modelling process with the help of real life case studies. Many concepts in predictive modelling methods are common and therefore, these concepts will be discussed in detail in this unit. A good understanding of predictive modelling leads to a smart data scientist as many business problems are related to successfully predicting future outcomes.

Learning Outcomes. When awarded credit for th	is Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
1 Carry out global and individual testing of	1.1 Evaluate dependent variables and predictors.
parameters used in defining predictive models.	1.2 Develop linear models using the Im function in R and
	the .ols function in Python.
	1.3 Interpret signs and values of estimated regression
	coefficients.
	1.4 Interpret output of global testing using F distributions.
	1.5 Identify significant and insignificant variables.
2. Validate assumptions in multiple linear	2.1 Resolve multicollinearity problems.
regression.	2.2 Revise a model after resolving the problem.
	2.3 Assess the performance of the ridge regression model.
	2.4 Perform residual analysis – graphically & using statistical
	tests to analyse results.
	2.5 Resolve problems of non-normality of errors and
	heteroscedasticity.
3. Validate models via data partitioning, out of	3.1 Develop models and implement them on testing data in
sample testing and cross-validation.	accordance with the specification.
	3.2 Evaluate the stability of the models using k-fold cross
	validation.
	3.3 Evaluate influential observations using Cook's distance
	and hat matrix.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 2 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

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Indicative Content

In this unit learners will cover core concepts used in predictive modelling, including the basics of statistical modelling, multi-linear regression and model validation.

Content includes:

- Concept of random variables and statistical distribution
- Concept of a statistical model
- Estimation of model parameters using Least Square Method
- Interpreting regression coefficients
- Assessing the goodness of fit of a model
- Global hypothesis testing using F distribution
- Individual testing using t distributions
- Concept of Multicollinearity
- Calculating Variance Inflation Factors
- Resolving problem by dropping variables
- Ridge regression method
- Stepwise regression as a strategy
- Residual analysis
- Shapiro Wilk test, K-S test and Q-Q plot for residuals
- White's test and Breusch-Pagan Test

- Partitioning data using the caret package
- Model development on training data
- Model validation on testing data using R squared and RMSE
- Concept of k-fold cross validation
- Performing k-fold cross validation using the caret package
- Identifying influential observations

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Mastering Predictive Analytics with R - Second Edition James D. Miller, Rui Miguel Forte Publisher Packt Publication date: August 2017 ISBN 9781787121393

Unit DS04: Advanced Predictive Modelling

Unit code: Y/618/4973

RQF level: 7

Aim

In this unit, learners are introduced to model development for categorical dependent variables. Binary dependent variables are encountered in many domains such as risk management, marketing and clinical research and this unit covers detailed model building processes for binary dependent variables. In addition, multinomial models and ordinal scaled variables will also be discussed.

Learning Outcomes. When awarded credit for thi	s Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
1 Develop models using binary logistic regression	1.1 Evaluate when to use Binary Linear Regression correctly.
and assess their performance.	1.2 Develop realistic models using functions in R and
	Python.
	1.3 Interpret output of global testing using Linear
	Regression Testing in order to assess the results.
	1.4 Perform out of sample validation that tests predictive quality of the model.
 Develop applications of multinomial logistic regression and ordinal logistic regression. 	2.1 Select method for modelling categorical variable.
	2.2 Develop models for nominal and ordinal scaled dependent variable in R and Python correctly.
3. Develop generalised linear models and carry	3.1 Evaluate the concept of generalised linear models.
out survival analysis and Cox regression.	3.2 Apply the Poisson regression model and negative
	binomial regression to count data correctly.
	3.3. Model 'time to event' variable using cox regression.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 3 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

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Indicative Content

In this unit students will cover binary logistic regression, multinomial and ordinal logistic regression, Poisson negative binomial and Cox regression.

Content includes:

- Model definition and parameter estimation
- Estimation of model parameters using MLE
- Interpreting regression coefficients and odds ratio
- Assessing goodness of fit of the model
- Global hypothesis testing using LRT distribution
- Individual testing using Wald's test
- Classification table
- ROC curve
- K-S Statistic
- Multinomial and Ordinal Logistic Regression model building and parameter estimation
- Interpretation of regression coefficients
- Classification table and deviance test
- Concept of GLM and link function and .GLM
- Poisson Regression
- Negative Binomial Regression

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- Survival Analysis Introduction
- Cox Regression

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Mastering Predictive Analytics with R - Second Edition James D. Miller, Rui Miguel Forte Publisher Packt Publication date: August 2017 ISBN 9781787121393

Unit DS05: Time Series Analysis

Unit code: D/618/4974

RQF level: 7

Aim

The objective of this unit is to discuss time series forecasting methods. Learners will analyse and forecast macroeconomic variables such as GDP and inflation. Panel data regression methods will also be discussed in this unit.

Learning Outcomes. When awarded credit for this	Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
 Assess the concepts and uses of time series analysis and test for stationarity in time series data. 	1.1 Create time series object in R and Python correctly including decomposing time series and assessing different components.
	1.2 Assess whether a time series is stationary.
	1.3 Transform non-stationary time series data into stationary time series data.
2. Validate ARIMA (Auto Regressive Integrated Moving Average) models and use estimation.	2.1 Identify p, d and q of ARIMA model using ACF (auto- correlation function) and a PACF (partial auto-correlation function) to describe how well values are related.
	 2.2 Develop ARIMA models using R and python and evaluate whether errors follow the white noise process. 2.3 Finalize the model and forecast n-period ahead to make
	accurate predictions.
3. Implement panel data regression methods.	3.1 Evaluate the concept of panel data regression.
	3.2 Analyse the features of panel data.
	3.3 Build panel data regression models in a range of contexts.
	3.4 Evaluate the difference between fixed effect and random effect models.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 2 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

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Indicative Content

In this unit students will cover binary logistic regression, multinomial and ordinal logistic regression, Poisson negative binomial and Cox regression.

Content includes:

- Components of time series
- Seasonal decomposition
- Trend analysis
- Auto-correlogram
- Partial auto-correlogram
- Dickey-Fuller test
- Converting non-stationary time series data into stationary time series data
- Concepts of AR, MA and ARIMA models
- Model identification using ACF and PACF
- Parameter estimation
- Residual analysis (testing for white noise process)
- Selection of optimal model
- What is Panel data?
- Need for different models for Panel data
- Panel data regression methods

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- Dummy variable method
- Random effect model

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Publisher: Hands on Time Series Analysis with R Rami Krispin Publisher: Packt Copyright Year: May 2019

Unit DS06: Unsupervised Multivariate Methods

Unit code: H/618/4975

RQF level: 7

Aim

Data reduction is a key process in business analytics projects. In this unit, learners will learn data reduction methods such as PCA, factor analysis and MDS. They will also learn to form segments using cluster analysis methods. Forming segments and then analysing is a key technique for large groups of data and their intrinsic information comes out in detail once segmented thoughtfully.

Learning Outcomes. When awarded credit for this	Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
1. Define Principal Component Analysis (PCA) and	1.1 Evaluate the need for data reduction.
its derivations and assess their application.	1.2 Perform principal component analysis and develop
	scoring models using R and python to minimise data loss
	and improve interpretability of data.
	1.3 Resolve multi-collinearity using Principal Component
	Regression.
2. Understand hierarchical and non-hierarchical	2.1 Perform data reduction and derive interpretable factors
cluster analysis and assess their outputs.	and use factor scores to interpret the data set.
	2.2 Obtain a brand perception map using multi-dimensional
	scaling.
3. Evaluate the concept of panel data regression	.3.1 Evaluate the need for cluster analysis.
and implement panel data methods.	3.2 Obtain clusters using suitable methods.
	3.3 Interpret cluster solutions and analyse the use of
	clusters for business strategies.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 2 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

The postgraduate diploma in data science is delivered online through our Canvas learning management system, supported by the use of online collaborative tools such as Zoom and Slack for live group online sessions, one-to-one mentoring and group messaging. Learners are provided with highly structured and detailed course content, broken down into nine distinct units covering core skills and knowledge. This includes recorded video presentations, comprehensive lecture slides, sample code for practice, quizzes and regular practice assignments. In addition, learners participate in regular scheduled online group sessions and have the opportunity to interact with mentors throughout the course.

Indicative Content

In this unit students will cover Principal Component Analysis, Factor Analysis and Multidimensional Scaling and Cluster Analysis. Details of the content are as follows:

- Concept of Data reduction
- Definition of first, second, ... ph principal component
- Deriving principal component using Eigenvectors
- Deciding optimum number of principal components
- Developing scoring models using PCA
- Principal component regression
- Orthogonal factor model
- Estimation of loading matrix
- Interpreting factor solution
- Deciding optimum number of factors
- Using factor scores for further analysis
- Factor rotation
- Concept of MDS
- Variable reduction using MDS
- Concept of cluster analysis
- Hierarchical cluster analysis methods (linkage methods)

- Using dendrogram to estimate optimum number of clusters
- k-means clustering methods
- Using k-means runs function in R and Python to find optimum number of k

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Applied Unsupervised Learning with R Publisher: Packt R Copyright Year: March 2019 ISBN 9781789956399 Alok Malik, Bradford Tuckfield

Unit DS07: Machine Learning

Unit code: K/618/4976

RQF level: 7

Aim

Machine learning algorithms are new generation algorithms used in conjunction with classical predictive modelling methods. In this unit, learners will understand applications of various machine learning algorithms for classification problems.

Learning Outcomes. When awarded credit for this	Assessment Criteria. Assessment of this learning outcome
unit, a learner will be able to:	will require a learner to demonstrate that they can:
1. Appraise classification methods including Naïve Bayes and the support vector machine algorithm.	1.1 Evaluate different methods of classification and the performance of classifiers.
	 Design optimum classification rules to achieve minimum error rates.
 Apply decision tree and random forest algorithms to classification and regression 	2.1 Use decision trees for classification and regression problems in comparison with classical methodologies.
problems.	2.2 Analyse concepts of bootstrapping and bagging.
	2.3 Apply the random forest method in a range of business and social contexts .
3. Analyse Market Baskets and apply neural networks to classification problems.	3.1 Analyse transactions data for possible associations and derive baskets of associated products.
	3.2 Apply neural networks to a classification problem in domains such as speech recognition, image recognition and document categorisation.

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 3 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

Delivery Guidance

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Indicative Content

In this unit students will cover Principal Component Analysis, Factor Analysis and Multidimensional Scaling and Cluster Analysis. Details of the content are as follows:

- Bayes theorem and its applications
- Constructing classifier using Naïve Bayes method
- Concept of Hyperlane
- Support vector machine algorithm
- Comparison with Binary Logistic Regression
- Basics of Decision Tree
- Concept of CART
- CHAID algorithm
- ctree function in R
- Bootstrapping and bagging
- Random forest algorithm
- Definitions of support, confidence and lift
- Aprioiri algorithm for market basket analysis
- Neural network problem for classification problem

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Supporting Text

Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas Muller Publisher: O'Reilly 2016 ISBN10 1449369413 ISBN13 9781449369415

Unit DS08: Further Topics in Data Science

Unit code: M/618/4977

RQF level: 7

Aim

In this module, learners will learn how to analyse unstructured data using text mining. The focus will be on sentiment analysis of text data, including data available on social media. For building interactive web apps straight from R, the concept of the "SHINY" package will be introduced. Big Data concepts and artificial Intelligence will be covered in the unit, as well as an introduction to SQL programming and how it is used to handle data.

Learning Outcomes. When awarded credit for this unit, a learner will be able to:	Assessment Criteria. Assessment of this learning outcome will require a learner to demonstrate that they can:	
1. Perform text mining on social media data.	 1.1 Appraise the concepts and techniques used in text mining. 	
	1.2 Analyse unstructured data and perform sentiment analysis of Twitter data to identify the positive, negative or neutral tone of the text.	
2. Develop web pages using the SHINY package.	2.1 Build interpretable dashboards using the SHINY package.	
	2.2 Host standalone applications on a web page to present the results of data analysis.	
3. Apply the Hadoop framework in Big Data Analytics.	3.1 Evaluate core concepts of Hadoop.	
	3.2 Appraise applications of Big Data Analytics in various industries.	
•	3.3 Evaluate the use of the HADOOP platform for performing Big Data Analytics.	
4. Evaluate the fundamental concepts of artificial intelligence.	4.1 Build a simple AI model using common machine learning algorithms that support business analysis and decision- making. In comparison with traditional assumptions from business theory.	
5. Use SQL programming for data analysis.	5.1 Evaluate core SQL for data analytics.	
	5.2 Carry out data wrangling and analysis in SQL to uncover insights in underutilized data.	

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

- Formative: Weekly assignments focussing on knowledge and understanding of technical skills using sample data sets over a period of 3 weeks and participation in weekly live classrooms and discussion groups;
- Summative: 1. Formal timed exam testing technical knowledge 2. Component of two individual course projects based on real word data analytics

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Indicative Content

In this unit students will cover text mining, the SHINY package, big data analytics, artificial intelligence concepts and SQL programming. Details of content are as follows:

- What is text mining?
- Term Document Matrix
- Word cloud
- Establishing connection with Twitter using twitteR package and Tweepy in Python
- Introduction to SHINY
- Introduction to R Markdown
- Build dashboards
- Host standalone apps on a webpage or embed them in R Markdown documents or build dashboards.
- What is Big Data?
- Features of Big Data (Volume, Velocity and Variety)
- Big Data in different industries (Healthcare, Telecom, etc.)
- HADOOP architecture
- Introduction to R HADOOP package
- What is AI and Theory behind AI
- What is Q learning

- The Monte Carlo theory
- SQL programming Basics
- Data Wrangling and analysis
- Text mining of Twitter data

Core Text

Applied Multivariate Statistical Analysis: Pearson New International Edition Richard Johnson, By (author) Dean Wichern Publication date 24 Jul 2013 Publisher Pearson Education Limited ISBN10 1292024941 ISBN13 9781292024943

Unit DS09: Contemporary Themes in Business Strategy

Unit code: T/618/4978

RQF level: 7

Aim

The convergence of Cloud computing, Big Data, Artificial Intelligence and The Internet of Things will see organisations of all shapes and sizes either survive and thrive or face extinction. New operational and strategic norms, types of organisations, the nature of work and employment are changing fundamentally across vast parts of the global economy. This unit introduces learners to the strategic and managerial challenges generated by the impact of digital technology on business and organisations.

Lea	Learning Outcomes. When awarded credit for this Assessment Criteria. Assessment of this learning outcome				
unit, a learner will be able to:		will require a learner to demonstrate that they:			
1.	Evaluate the concept of transformation and the key technologies that drive it.	nalyse the technologies that under ransformation. ssess the managerial challenges a mplementing digital transformatic	erpin digital ssociated with on successfully.		
2.	Assess the strategic impact of the application of Big Data and Artificial Intelligence on business organisations.	valuate theories of strategy and the digital economy and business. Analyse examples of the application ntelligence on business operations	heir application to n of Artificial s or strategy.		
3.	Appraise theories of innovation and distinguish between disruptive and incremental change.	valuate theories of disruptive inner explain the impact of innovation or evaluate the managerial challenges mplementing innovation within or	ovation and how they n industries. s of promoting and ganizations.		
4.	Evaluate ethics practices within organisations and how they relate to issues in Data Science.	ssess the role that codes of ethics peration and sustainability of org valuate the importance of reporti ethical practice.	play in the anisations. ng and disclosure for		

To demonstrate all learning outcomes and assessment criteria, each unit should follow the same assessment methodology:

Summative: For this unit learners are required to carry out a review of the literature that covers the learning outcomes and assessment criteria demonstrating a sound theoretical basis of understanding and the ability to contextualise concepts within practical real world scenarios.

Delivery Guidance

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Indicative Content

- Fundamentals of Cloud Computing
- Compare and contrast cloud computing with traditional computing models
- Software as a Service
- Platform as a Services
- Infrastructure as a Service
- Business impact of Cloud Computing
- Historical development of Artificial Intelligence
- Vs of data Volume, velocity, variety, veracity and value
- Christensen's theory of disruptive innovation
- Ethical dilemmas and issues in Artificial Intelligence and Big Data

Core Text

The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail (Management of Innovation and Change) ISBN-10: 1633691780 Clayton Christensen Harvard Business Review Press Jan. 2004 Competing in the Age of AI: Strategy and Leadership When Algorithms and Networks Run the World by Marco Iansiti (Author), Karim R. Lakhani (Author) Harvard Business Review Press Jan. 2020 ISBN-10: 1633697622 ISBN-13: 978-1633697621

Digital Transformation Tom Siebel Rosetta Books 2019 SBN-13: 978-1948122481 ISBN-10: 1948122480