University of the
West of England
BRISTOL

CORPORATE AND ACADEMIC SERVICES

MODULE SPECIFICATION

Part 1: Basic Data						
Module Title	Machine Learning and Predictive Analytics					
Module Code	UFCFMJ-15-M		Level	M	Version	1
Owning Faculty	FET		Field		Computer Science and Creative Technologies	
Contributes towards	MSc Information Technology					
UWE Credit Rating	15	ECTS Credit Rating	7.5		Module Type	Standard
Pre-requisites	None		Co- requisites		None	
Excluded Combinations	None		Module Entry requirements		None	
Valid From			Valid to			

CAP Approval Date	

Part 2: Learning and Teaching

Learning Outcomes	On successful completion of this module students will be able to: 1. Define and critique through example the concepts of predictive analytics, machine learning and data mining [A] 2. Differentiate analytical models: the predictive, descriptive and survival [A] 3. Synthesise evidence on the value of data as an asset for businesses to "mine" knowledge and "predict" trends [A,B] 4. Identify learning problems including classification, clustering and reinforcement; distinguish their scope and outline suitable solutions [A]. 5. Develop and evaluate predictive analytics approaches and techniques such as regression and random forest classifiers [B] 6. Apply problem solving skills necessary for identifying the organisational capacity needed to employ a predictive analytics solution [B] 7. Visualise and present the results of predictive and descriptive models alongside an evaluation of performance and recommendations for improvement [B] 8. Understand predictive analytics trends and challenges and illustrate fluency with software tools used in predictive analytics [A,B]
Syllabus Outline	**Introduction to predictive analytics** • Defining predictive analytics - introduction • Business Relevance of PA - Business intelligence and applications

    o Relevance of pattern recognition, classification, optimisation
- Predictive analytics and big data
- Case study: a business application using predictive analytics approaches

Predictive analytics in business - applications
- Sources of data and value of knowledge
- Identify a wide range of applications for predictive analytics:
  - marketing and recommender systems, fraud detection, business process analytics, credit risk modelling, web analytics and others
  - Social media and human behaviour analytics
- Case study: email targeting - which message will a customer answer? - [tutorial]

Analytics models and techniques
- Introduction to analytics modelling
- Types of analytics models:
  - Predictive models
  - Survival models
  - Descriptive models
- Define pattern recognition, inferring data and data visualisation
- Briefing learning and regression approaches
- Comparison of approaches - use and goals - [tutorial]

Introduction to machine learning
- Introduction: Basic principles
  - Basic notions of learning
  - Introduction to learning problems (classification, clustering and reinforcement) and literature
  - Identifying different learning approaches - supervised, unsupervised and reinforcement
- Case study on different types of learning - [tutorial]

Machine learning for predictive analytics [1]
- Review of types of problems
- Machine Learning techniques:
  - Decision tree learning
  - Artificial neural networks
  - Clustering
  - Naive Bayes classifier
  - k-nearest neighbours
  - Genetic algorithms
- Case study on problem - a "suitable" predictive modelling technique - [tutorial]

Regression techniques for predictive analytics
- Review of types of problems (application)
- Linear regression models
- Survival or duration analysis (time to event analysis)
- Ensemble learning and random forest
- Case study on problem - a "suitable" predictive modelling technique - [tutorial]

Advanced topics and Software tools
- Analytics in the context of big data
- Predictive analytics as art and science
- Software tools; the R project and Python
- Trends and challenges in predictive analytics - where are we going?

Contact Hours	This module will involve 2 hours contact time per week for one semester equally divided between lecture and tutorial sessions.
	Activity hrs Contact time 24 Assimilation and development of knowledge 86 Exam preparation 20 Coursework preparation 20 **Total study time 150**
Teaching and Learning Methods	The module is delivered through weekly combined lecture and tutorial sessions. Each session will direct the course and introduce the new ideas and skills required. Then tutorial sessions will enable each student to carry out the study and research exercises described in the associated work-sheet under the guidance of a Tutor. The teaching material will be made available from Blackboard. A course text is also recommended. **Scheduled learning** includes lectures and tutorials. **Independent learning** includes time engaged with essential reading and assignment preparation and completion.

Reading Strategy	**Core readings**
	Core readings and books will be set out in the Module Handbook made available on Blackboard and additionally through weekly Learning Materials folders. Alongside academic texts, a range of web-based resources/portals will be used and the following will be referred to for current case studies, news and real-world examples:
	
	    • KD Nuggets http://www.kdnuggets.com/
	    • Kaggle https://www.kaggle.com/
	
	Further readings
	Students are expected to identify all other reading relevant to the module topics themselves. They will be encouraged to read widely using the library search, a variety of bibliographic and full text databases, and internet resources. Many resources can be accessed remotely.
	
	Access and skills
	Additional support is available through the Library Services web pages, including interactive tutorials on finding books and journals, evaluating information and referencing. Postgraduate study skills resources will also be available through Blackboard.

Indicative Reading List	*The following list is offered to provide validation panels/accrediting bodies with an indication of the type and level of information students may be expected to consult. As such, its currency may wane during the life span of the module specification. However, as indicated above, CURRENT advice on readings will be available via other more frequently updated mechanisms.*
	Christopher Bishop (2007), Pattern Recognition and Machine Learning (Information Science and Statistics), *Springer, ISBN: 978-0387310732*
	Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar (2012) Foundations of Machine Learning (Adaptive Computation and Machine Learning series), *The MIT Press ISBN: 978-0262018258*
	Max Kuhn, Kjell Johnson (2013), Applied Predictive Modeling, *Springer; 2013 edition ISBN: 978-1461468486*
	John D. Kelleher, Brian Mac Namee and Aoife D'Arcy (2015) Fundamentals of Machine Learning for Predictive Data Analytics - Algorithms, Worked Examples, and Case Studies, *The MIT Press ISBN: 9780262029445*
	Jared Dean, (2014), Big Data, Data Mining, and Machine Learning - Value Creation for Business Leaders and Practitioners, *Publisher Wiley, ISBN: 978-1-118-61804-2*
	Bart Baesens (2014), Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, *Wiley, ISBN: 978-1-118-89270-1*
	Thomas W. Miller (2014), Modeling Techniques in Predictive Analytics with Python and R: A Guide to Data Science*, Pearson FT Press, ISBN: 978-0-13-389206-2*
	McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D.J., and Barton, D. (2012) Big Data: The Management Revolution, *Harvard Business Review 90(10):61–67.*
	Schoenherr, Tobias and Speier-Pero, Cheri (2015), Data Science, Predictive Analytics, and Big Data in Supply Chain Management: Current State and Future Potential, Journal of Business Logistics, *Journal of Business Logistics, vol. 36, Issue 1, pages 120–132, March 2015, DOI: 10.1111/jbl.12082*
	Lycett, M. (2013) Datafication: Making Sense of (Big) Data in a Complex World. *European Journal of Information Systems 22(4):381–86.*

Part 3: Assessment

Assessment Strategy	The Component B, coursework involves solving a business related problem based on given requirements and data, proposing a solution and preparing a pilot predictive model. This component brings together module material on the context, data and requirements for implementing a predictive module and in the course of completion students will gain experience in model building, presenting results and evaluating accuracy.
	The component A grade will be obtained from an exam to be taken at the completion of teaching. This component will consist of a number of questions which should test the students understanding of the fundamental concepts presented in the course materials as well as their understanding and ability to selectively apply those concepts and ideas to real-life scenarios (case studies).
	There will be opportunities for formative assessment in the form of regular in-class presentations of research/implementation completed as part of tutorial work completed, group discussions, and progress reviews of the coursework project.

Identify final assessment component and element	Component A	
% weighting between components A and B (Standard modules only)	**A:**	**B**:
	50	**50**

First Sit	
Component A (controlled conditions) **Description of each element**	**Element weighting** **(as % of component)**
1. Exam (3 hours)	100%
Component B **Description of each element**	**Element weighting** **(as % of component)**
2. Individual Course Work Report (2000 Words)	100%

Resit (further attendance at taught classes is not required)	
Component A (controlled conditions) **Description of each element**	**Element weighting** **(as % of component)**
1. Exam (3 hours)	100%
Component B **Description of each element**	**Element weighting** **(as % of component)**
2. Individual Course Work Report (2000 Words)	100%

If a student is permitted an **EXCEPTIONAL RETAKE** of the module the assessment will be that indicated by the Module Description at the time that retake commences.