UNIVERSITY OF WEST LONDON
The Career University

MARBELLA INTERNATIONAL UNIVERSITY CENTRE

Module Study Guide

Academic Year 2020–2021

(Spring Semester)

AI-PMB – Artificial Intelligence: Predictive Modelling in Business

Level: 6

Credits: 5 ECTS; 10 UK credits

Academic Partner:

Marbella International University Centre (MIUC)

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The External Examiner responsible for this module is Professor Nick Rees (Professor of International Relations and Dean of the School of Humanities and Social Sciences) for International Business and International Relations courses and Dr. Ana Gaio (Programme Director MA Culture, Policy and Management, City University of London) for Marketing and Advertising course.

The Academic Partner Link-Tutor responsible for this module is Brenda Theodore-Marks (for International Business and International Relations courses) and Matilde Nardelli (for Marketing and Advertising course), and can be contacted at Brenda.Theodore-Marks@uwl.ac.uk and Matilde.Nardelli@uwl.ac.uk

1 Module overview

1.1 Introduction, aims and summary of content

Artificial intelligence is an area of computer science that aims to make electronic devices the smartest possible in such a way that they can 'learn' either from data or interaction with any device's users. With every single use of technology, a new record containing information related to a certain activity can potentially be tracked.

Dealing with this information is a real challenge in the IT community in order to improve elements such as cost-related procedures, customers' assessment or global human health.

1.2 Module summary content and aims

The Artificial Intelligence module is designed to provide you the knowledge in how to address and solve real-life problems based on data: you will get expertise in supervised, unsupervised and reinforcement learning, which are the three main branches of machine learning, and will also learn how to build predictive models of different nature (parametric and non-parametric) that will allow you to predict an event of interest for a new given record.

The module is composed mainly of lectures and seminars and will run throughout the semester (14 weeks).

1.3 Learning outcomes to be assessed

At the end of the module you will be able to:

LO1. Discuss main supervised and unsupervised learning algorithms. (Summative Assessment 1)

LO2. Review further artificial intelligence learning algorithms (Summative Assessment 1)

LO3. Build predictive models of different nature (parametric and non-parametric). (Summative Assessment 1)

1.4 Scheduled contact hours

Teaching Contact Hours	56 hours
Independent Study Hours	44 hours
Total Learning Hours	100 hours

2 Assessment and feedback

2.1 Summative assessment grid

Type of Assessment	Word Count or equivalent	Threshold (if Professional Body-PSRB applies)	Weighting	Pass Mark	Submission due-date & time	Method of Submission & Date of Feedback
Build a predictive model (Final Project)	2000	n/a	100%	40	Week 15 (Date and Time TBC)	Via NEOLMS & 10 working days after in-class exercises

2.2 Assessment brief including criteria mapped to learning outcomes

2.2.1 Assessment 1: Final Project: Build a predictive model

In the assessment, you have to submit a final report that justifies all the modelling decisions made for the predictive model you built. During the semester, you will carry out a project in which you will have to provide a solution to a specific problem based on a case. You will be expected to choose an appropriate artificial intelligence model to make predictions and provide one evaluation strategy to assess the performance of the model.

The report could be structured in the following way:

- Introduction: provide an overview of the data and the event of interest that is being predicted.
- Materials and Methods: describe in detail the data and artificial intelligence techniques used in the project.
- Results: performance of the predictive model built in new unseen data.
- Conclusion: discussion and conclusion reached in the project.

Assessment criteria

Assessment criteria for Assessment 1 (LO1, LO2 and LO3 will be assessed)

These assessments will be marked according to the following criteria:

- **Knowledge and Understanding (20%):** Demonstrate an understanding of the principles, terms and concepts of the artificial intelligence and predictive modelling. The project report provides accurate information that shows the knowledge of the student in the availability of several supervised and unsupervised machine learning models. In addition, the report

includes the use of an evaluation strategy that allows the student to give a performance of the build model in future unseen data.

- **Cognitive Skills (20%):** Ability to analyze problems and apply learned concepts into multidisciplinary areas. For a given project, the student shows outstanding abilities in identifying and using artificial intelligence techniques, i.e., the student can choose the appropriate machine learning model to solve a specific problem among all the possibilities available.
- **Practical/Professional Skills (30%):** Independence, capacity, creativity and initiative to provide practical solutions to the questions proposed. Given a specific problem and once the appropriate machine learning model is identified, the student demonstrates the ability to use standard tools and build a predictive model capable of predicting the desired outcome for new unseen samples with an acceptable predictive accuracy.
- **Transferable Skills (30%):** Demonstrate outstanding skills in presenting information and results. Independent work abilities with minimal guidance will also be considered. The report is well-structured and contains a clear explanation on each decision made during the different stages involved in predictive modelling.

For guidance on online submission of assignments, including how to submit and how to access online feedback, please refer to the MIUC NEOLMS student guideline.

2.3 Learning materials

The reading list for this module is available on NEOLMS in the module area.

2.3.1 Core textbook(s):

- Russel, S., Norvig, P. (2014). *In Artificial Intelligence: A Modern Approach* 3rd Edition. Pearson Education Limited.

2.3.2 Other recommended reading:

- Burkov A. (2019). *The Hundred-Page Machine Learning Book*. The ML Book.
- Neapolitan R. E., Jiang X. (2018): *Artificial Intelligence: With an Introduction to Machine Learning.* Chapman and Hall/CRC.

2.3.3 Other resources:

- Mehryar M., Rostamizadeh A., Talwalkar A. (2018): *Foundations of Machine Learning.*The MIT Press.
- Shalev-Shwartz S., Ben-David S. (2014): *Undestanding Machine Learning: From Theory to Algorithms.* CUP.

Remember to log into NEOLMS daily to receive all the latest news and support available at your module sites!

3 Things you need to know

3.1 Engagement

During the academic year 2020-21, the health, welfare, and safety of all our students and staff is our top priority as Spain continues to deal with the ongoing implications of the COVID-19 outbreak.

Face to-face-teaching, access to MIUC facilities and being part of our unique University community are key parts of the excellent student experience at MIUC. We have been working to create a safe and efficient plan that will allow us to deliver these elements when you start with us in the fall semester, subject to government regulation.

MIUC will be ready to teach in September and we are committed to engaging with you as closely as we can, and to ensuring that you have a rich educational experience that is safe and protected to ensure that you continue to get the most from the University life and the city of Marbella.

Whether you are engaging with teaching and learning activities on site or via the MIUC Virtual Learning Environment, we expect the same level of commitment and engagement from you. If you are unable to attend scheduled on site or online activities or complete activities in the timeframes set out, you should let your module leaders know. You should aim to stick to assessment deadlines; if you are concerned that you will not be able to complete your assessments on time, you should talk to your module leaders. Your engagement, whether online or on site, will be tracked and if we see that you are not engaging, we will get in contact with you. However, we encourage you to let us know if you are struggling so we can work with you to find solutions and get you back on track as soon as possible. Give yourself the best possible chance to succeed by engaging with the full range of learning and teaching activities available to you.

3.2 Need help, just ask

The University recognises that there are times when you may encounter difficulties during your course of study and provisions are made to help you. If you are struggling with meeting deadlines please talk to us, whether it's your course/module leader, personal tutor or any member of staff, speak to them so they can get you the support you need to succeed. You can extend your deadline if you have a good reason why you are not able to submit a piece of coursework on time, apply online for an extension before your deadline. An extension will allow you an extra 10 working days. If an extension is not sufficient and circumstances beyond your control are preventing you from completing your assessment, then you can, apply online for mitigation.

Please remember late submission without extension or mitigation will result in penalties depending on how late it is, see Academic Regulations.

You are reminded that MIUC applies penalties to students who commit an academic offence, in which case the Academic Offences Regulations will be used to deal with any cases of academic misconduct including examination offences, plagiarism and other means of cheating to obtain an advantage.

You are encouraged to seek advice from the Students' Union and counselling service which support you with all aspects of your academic experience by providing advice and guidance to ensure you are fully informed of the academic regulations as well as advocate for student views.

You are expected to behave in line with University expectations, irrespective of whether your interactions with staff and other students are in person or online. As you will be engaging with others

online and a range of online materials, it is important to consider how to stay safe online and ensure your communications are secure and appropriate. If you have any questions about how to manage your online activities, please contact your module leader.

If you have an issue about the module, you should speak to your Module Leader or Course Leader informally in the first instance. Your Course Representative can also raise your concerns at Course Committees, which take place each semester. If you are unable to resolve it informally, you should refer to the Complaints Procedure which is outlined in the student handbook and consult the Students' Union about it. The University aims to ensure that issues are resolved informally as quickly as possible to have minimum impact on your studies.

3.3 Getting support for your studies

Throughout your course of study, you will have access to a wide variety of sources of support depending on your individual circumstances and needs. Your first point of call for getting general academic support is your Personal Tutor. As well as approaching your Module Leader with any questions specifically related to your module and your Course Leader with questions on your Course, do contact your Personal Tutor for academic advice in relation your studies and your academic development.

Apart from the University-wide support framework, which encompasses the Module Leaders, Course Leader, the Subject Librarian and your Course Administrator, you will also have at your disposal the MIUC Academic Support Team. The Team offers Academic Skills Workshops throughout the year, helping you to develop skills relevant to your degree. Workshops include for instance Essay Planning and Writing; Critical Thinking; Reflective Writing; Group Work and Presentation Skills.

English Language support and One-to-one academic support opportunities are also available. For information about all these services, please consult the Academic Office.

3.4 Student support

In addition to the support listed in the previous section, there is also more help offered by MIUC Student services, consisting of Student Life Department, Internship Support, Life Coaching Service and Counselling service. They offer a wide range of support and services consisting of extracurricular activities; Careers and internship support; Student Welfare and Counselling.

Contact Student Services for more information at:

Student Life Department:student.life@miuc.org

Internship Support: TBC

Life Coaching Service: Ms. Ana Cantle, ana.cantle@miuc.org

Counselling Service: Ms. Eva Berkovic, eva@miuc.org

3.5 Module evaluation – have your say!

Towards the end of the module you will be invited to provide some anonymous feedback to the Module Leader through a(online) survey. This is your opportunity to give some direct feedback about the module through a series of questions and free text. Your constructive feedback will help the Module Leader and teaching team to understand the module experience from your perspective and helps inform the development of the module.

4 Appendix: Weekly Content

Week 1 - Introduction to Artificial Intelligence and Machine Learning.

Key concepts/issues:
Course introduction; Artificial Intelligence; Machine Learning

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 1. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 1. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.

Independent study:
Download and install R, RStudio, Weka
Description:
This session will introduce you to the module organization, structure and assessments. You will be exposed to the time commitments you will need to make and the skills you will develop through the duration of the module. Furthermore, you will get an understanding of what artificial intelligence and machine learning refer to.

Week 2 - Artificial intelligence: types of algorithms

Key concepts/issues:

Search algorithms; Knowledge-based algorithms; Learning algorithms

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 1. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 1. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.

Independent Study:
Assigned Reading

Description:
In this session, you will be introduced to a brief classification of artificial intelligence algorithms like search, knowledge-based and learning ones. You will be able to learn the philosophy behind each of these types of algorithms and when they are suitable to be applied.

Week 3 - Evaluation strategies for machine learning models

Key concepts/issues:

Performance measures; Cross-validation

Literature for this session:

- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 5. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapter 8. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:

In this session, you will be introduced to several performance measures typically used to measure how good is your predictive model. You will learn that performance measures may be different depending on whether you are addressing a regression or a classification problem. Moreover, you will be also introduced to cross-validation as one of the most used evaluation strategies for machine learning models.

Week 4 - Linear models

Key concepts/issues:

Linearly separable; Regression; Classification.

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 18. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapters 2, 3. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapters 10, 15, 21, 22. In*The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:

In this session, you will be introduced to the simplest predictive model in machine learning: linear models. You will learn that this type of model is suitable when it exists a linear relationship between the dependent and independent variables. Moreover, you will learn the concepts of regression and classification problems.

Week 5 - Regularization

Key concepts/issues:

L1 and L2 penalties; Over-fitting; Feature selection

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 18. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 6. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapters 13, 22. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:
In this session, you will be introduced to the concept of over-fitting when building a linear predictive model. You will learn to simple strategies to overcome over-fitting by adding L1 or L2 penalties as a regularization technique. Moreover, you will learn that L1-regularization allows to perform feature (or variable) selection.

Week 6 - k-Nearest Neighbours

Key concepts/issues:

Distance definition; Non-parametric model; Local position

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 18. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapter 11. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises
Description:
In this session, you will be introduced to a non-parametric machine learning model which is based on similarity measures. You will learn how to define a similarity measure to see how far (or different) are two sample of your data and use this criterion to build a predictive model restricted to the k-neighbours more similar to the one that you want to get the predictions for.

Week 7 - Random Forest

Key concepts/issues:
Decision tree; Bagging

Literature for this session:

- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapters 8, 9. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:
In this session, you will be introduced to a non-parametric machine learning model which is based on decision trees. You will learn how a decision tree is built and how a random forest is an ensemble of multiple decision trees built on slightly different views of the data. In this sense, you will learn the concept of bootstrap and bagging in machine learning.

Week 8 - Support Vector Machines

Key concepts/issues:

Kernel-based model; Types of kernels

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 18. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.
- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 9. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapters 5, 19, 24. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:
In this session, you will be introduced to one type of kernel-based models: support vector machines. You will learn how the kernel trick helps you to project a non-linearly separable problem to another space in such a way that now is linearly separable. Moreover, you will be introduced to different well-known kernels available in this kind of machine learning models.

Week 9 - K-Means algorithm

Key concepts/issues:

Clustering; Distance-based measure; Types of distances

Literature for this session:

- James, G., Witten, D., Hastie, T., Tibshirani, R (2013) Chapter 10. In *An Introduction to Statistical Learning with Applications in R*. Springer Texts in Statistics.
- Hastie, T., Tibshirani, R., Friedman, J. (2009) Chapters 2, 26. In *The Elements of Statistical Learning*. Springer Texts in Statistics.

Independent Study:
Complete exercises

Description:
In this session, you will be introduced to the simplest unsupervised machine learning model: k-means. You will learn to use this model to perform predictions or discover clusters in your data by using different distance definitions.

Week 10 - Non-negative matrix factorization

Key concepts/issues:
Latent variable; Matrix decomposition; Recommender system
Literature for this session:

- R bloggers.

https://www.r-bloggers.com/nonnegative-matrix-factorization-and-recommendor-systems/
https://www.r-bloggers.com/quick-intro-to-nmf-the-method-and-the-r-package/

Independent Study:
Complete exercises

Description:
In this session, you will have a brief introduction to a more complex unsupervised model named non-negative matrix factorization. You will learn how to discover cluster by decomposing your original data matrix into a product of two matrixes. Moreover, you will learn that this kind of models are typically used by recommender systems such as Amazon, Ebay, etc.

Week 11 - Evolutionary Algorithms: representation and heuristic optimization

Key concepts/issues: Data representation; Chromosome; Local search; Heuristics; Population evolution; Cross-over and mutation operations

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 4. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.

Independent Study: Complete exercise

Description:

In this session, you will be introduced to the family of evolutionary (or genetic) algorithms. You will learn the main philosophy of this search algorithm inspired in biology. Moreover, you will learn how to define a representation of your problem in order to address it using an evolutionary algorithm. You will also learn how given an initial representation of your problem, the evolutionary algorithm evolves it to get an acceptable solution through cross-over and mutation operations (again inspired in biology).

Week 12 - A* search strategy

Key concepts/issues: Minimization cost; Optimality

Literature for this session:

- Russel, S., Norvig, P. (2014) Chapter 3. In *Artificial Intelligence: A Modern Approach*. 3rd edition. Pearson Education Limited.

Independent Study: Complete exercise

Description:

In this session, you will be introduced to one type of search algorithm in artificial intelligence: the A* search strategy. You will learn the main concepts of this algorithm bases on the minimization of a cost function, something typically used, for instance, in video games where the computer is able to play against the user.

Week 13-14 - Project submission and Recapitulation, Remarks, Doubts

Key concepts/issues: Recapitulation, Remarks, Doubts

Literature for this session:

- Review of previous material
- Submit the assessment on Week 13

Description:

In this session, we will review the material covered in class and you will have the opportunity to solve your doubts to deepen your knowledge.

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