



## SUBJECT TECHNICAL SHEET

Subject data	
ECTS credits	3
DEGREE	Master in Finance / University Master in Finance from the Pontifical University of Comillas
Manager / Teacher	Francisco Gomez Casanova
Name	Big Data & Artificial Intelligence in Finance
Mail	<a href="mailto:f.gomez@advantere.org">f.gomez@advantere.org</a>

## OBJECTIVES AND CONTENTS

### OBJECTIVES

#### General Competencies

**CG.1:** Project-based learning: Ability to develop and execute in its different phases collective financial projects based on real situations, proposing real solutions and making efficient all interactions with the team, clients and any other participant

- **RA1:** Ability to engage in the development of experimental collective projects based on the real world, managing and aligning the client's needs with the available resources, optimally distributing the work, communicating and projecting its different phases, proposing real solutions and making efficient all interactions with the team, clients and other stakeholders.

**CG.3:** Teamwork: Apply techniques and methodologies that promote teamwork and mutual collaboration in talent management projects to be carried out with companies and organizations

- **RA1:** Be committed to and cooperate in the roles defined for the achievement of the goals related to the defined and assigned tasks, activities, projects and responsibilities

**CG.9:** Digital competence: Employ, take advantage of and use, in an efficient and safe manner, the technological and digital resources applied in the financial management of organizations

- **RA1:** Be able to critically, creatively and safely use information and communication technologies in financial management in organizations, using applications and taking advantage of Internet resources

**CG.10:** Technical Capacity: Capacity of analysis, synthesis and projection, applied to situations, problems and models in the financial field

- **RA1:** Be able to deal with the analytical study of cases and scenarios, as well as to carry out synthesis of information and data



### Specific Competencies

**CE.05:** In-depth knowledge of new business activities within the financial sector, as well as value generation processes based on new technologies and their impact on the current and future financial ecosystem

- **RA1:** Know the evolution and triggers within the financial industry of the disruption of new technology-intensive business models while understanding the profound impact on both the value chain and performance of these companies as well as on the dynamics of competition within the financial industry generated by these same technologies within the financial industry itself that these same technologies generate

**CEOPT2:** Know and apply modeling and data analytic techniques to estimate investor and/or market behavior, as well as to create investment risk management strategies and models, and how artificial intelligence, process automation and machine learning can optimize these processes and make them more efficient

- **RA1:** Know how to identify and measure the different types of risks (operational, credit, market) in financial institutions and financial products
- **RA2:** Design and use quantitative models generated in Matlab, R-Studio and/or Python from Artificial Intelligence techniques for risk control
- **RA3:** Know and know how to apply new methodologies, techniques and technologies that directly and indirectly impact data analysis models



## CONTENTS

### 1.- BigData and Machine-Learning Introduction & General concepts

#### What is Big Data ?

- Exploratory Data Analysis (EDA)
- Supervised / Unsupervised machine-learning
- Bias, Overfitting & Cross-validation
- Regularization & Hyperparameter tuning
- Machine-Learning useful libraries
- Case application : Optimization of a multi-variate function using TensorFlow optimizers.

### 2A.- Supervised learning / Binary classification problems

- Logistic regression
- Confusion matrix
- Support Vector Machines (SVM)
- Ensemble methods
- Classification for unbalanced problems
- Case application : Loan approval prediction

### 2B.- Supervised learning / Multi-class classification problems

- Tree information gain : Gini impurity, Entropy
- Multi-class learning
- Regression trees and ensemble methods
- Case application : Credit rating prediction

### 3.- Supervised learning / Regression with multiple variables

- Deep Neural Networks (DNN)
- Longstaff-Schwartz method
- Regression with multiple variables
- CostFunction / Optimization methods
- Regularization techniques & Activation function
- Model backtesting : Assuring correct model prediction in the future
- Case application : Derivatives NPV approximation

### 4.- Auto-Encoders (AE) & Variational Auto-Encoders (VAE)

- Latent variables
- Generative models
- Case application : IRates extrapolation & IRates curve generation

### 5.- Further topics and its applications :

- More on Big Data
- More neural networks : CNN, LSTM, NLP
- Unsupervised learning & Reinforcement learning



## TEACHING METHODOLOGY

### General methodological aspects of the subject

#### **Teaching of classes**

Firstly, the teaching team will make a presentation of the theoretical subject matter of the course based on blackboard presentations and explanations. Next, Notebooks will be used to specify the explanations and carry out their practical application in real use cases in the financial field.

#### **Individual study.**

Individual reading of different types of texts (cases, books, magazines, articles, press, Internet publications, reports on practical experiences, etc.) related to the study subjects.

**Cooperative work** of students who, in groups, receive a task that requires sharing information and resources among members with a view to achieving the common objective.

## EVALUATION AND GRADING CRITERIA

Evaluation activities	Weight (%)
Individual final evaluation	40%
Individual / Group practical cases	40%
Participation	20%



## Grading

**Class Participation:** Students will be evaluated for their proactive contribution in class by offering ideas and/or regularly asking questions and/or consistently working on the group project all the time. These ideas or questions should aim to enrich and/or expand discussions by relating the discussed topics to others, either from the same course or a different one. Students should listen without interrupting when others speak, either working in groups or in class, incorporating new angles into the discussion or elaborating more on other students' ideas. Additionally, contributing to the overall class environment and being positively prepared for sessions, i.e., covering the recommended readings for each session, will be taken into account.

Full attendance is mandatory (including class excursions/site visits, Master Classes, and informal sessions, among others) and will be checked at the beginning of each class; students who miss many classes or are frequently late will see a reduction in their participation grade. Personal trips do not constitute justified absences. Unjustified absences will have the following penalty on the class participation grade rubric:

- a. One unjustified absence: -15% reduction in the final class participation grade.
- b. Two unjustified absences: -40% reduction in the final class participation grade.
- c. More than two unjustified absences will cause a 60% reduction in the final class participation grade. The student will not be allowed to take the exam and will, therefore, be required to take the makeup exam. If the student passes the makeup exam, their final Class Participation grade will be limited to 5.0.

Tardiness is a sign of disrespect towards the professor and other students and should not be allowed. Therefore, students arriving more than 10 minutes late to class will have to wait outside until the break.

Finally, the role played in the final group project presentation will also be considered for this part of the final grade.

**Exercises, Case Studies, and Group Project:** Throughout the course, exercises based on real cases will be reviewed. To make the most out of the class, students are asked to prepare them in advance. Some of these exercises will be defined for individual completion and others in groups.

**Final Exam:** The final exam will generally consist of a set of multiple-choice questions, short/long essays, and/or practical exercises. The exam evaluates the understanding and analysis of all course concepts along with practical exercises based on the topics discussed in class.

A minimum grade of 5 (out of 10) is required on the final exam for all evaluation criteria (Participation/Exercises/Project) to be weighted as indicated in the program. An average weighted grade of more than 5 is required to pass the course.

If a student does not obtain at least a grade of 5.0 (out of 10), the student must take the "makeup" exam.

**Makeup:** The course grade will be calculated as follows: the makeup grade will be limited to the median grade of the students who passed the first exam. The final makeup grade will be weighted with the Class Participation, Exercises, and Group Project grades.



## BIBLIOGRAPHY AND RESOURCES

### Basic Bibliography

#### Books:

- Matthew F. Dixon, Igor Halperin & Paul Bilokon : Machine Learning in Finance: From Theory to Practice (2020)
- Aurelien Geron : Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow 3e: Concepts, Tools, and Techniques to Build Intelligent Systems - 2022
- Matthew F. Dixon, Igor Halperin & Paul Bilokon : Machine Learning in Finance: From Theory to Practice (2020)
- Tony Guida : Big Data and Machine Learning in Quantitative Investment (2019)
- Ofer Mendelevitch, Casey Stella , Douglas Eadline : Practical Data Science with Hadoop and Spark: Designing and Building Effective Analytics at Scale