Course guide
270246 - DSAF - Data Science Applied to Finances

Last modified: 10/07/2026

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.

Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2026 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: ARGIMIRO ALEJANDRO ARRATIA QUESADA

Others:

PRIOR SKILLS

Fundamentos de aprendizaje automático y ciencia de datos. Conocimientos básicos de modelos de aprendizaje automático, como redes neuronales y máquinas de vectores de soporte. Estadística básica. Conocimientos de Python (preferible) o R.

TEACHING METHODOLOGY

Las clases combinan teoría y práctica (se proporcionarán guiones de Python, y de manera addicional de R, para la exploración de modelos de series temporales y otros ejemplos). Se requiere asistencia a clase y la entrega de las tareas.

LEARNING OBJECTIVES OF THE SUBJECT

1.Aprender a diseñar y evaluar adecuadamente modelos de predicción financiera y estrategias de inversión basados en modelos de aprendizaje supervisado u otros modelos que utilicen distintos tipos de conjuntos de información (cuantitativa y cualitativa).
2.Adquirir conocimientos sobre los mercados financieros, su funcionamiento y sus productos y, en general, comprender el comportamiento de las series temporales financieras y sus propiedades estadísticas.

STUDY LOAD

Type	Hours	Percentage
Self study	50,0	66.67
Hours large group	25,0	33.33

Total learning time: 75 h

CONTENTS

An abridged introduction to finance and ML

Description:
Securities (bonds, stocks,derivatives); price and payoff; market indices; market jargon; financial markets zoo. Pricing basic financial contracts. Essential aspects of data exploration and learning. A review of software in Python for finance and ML.

Statistics of Financial Time Series

Description:
Descriptive statistics of financial time series. Returns. Stylized facts of financial returns. Forecasting (formal definition). Volatility.

Time series model adequacy methods.

Description:
Time series model adequacy. Causality. Independence. Correlation. The stationary bootstrap (for synthetic replication of time series). Feature selection through LASSO. (These are all useful techniques to select features for our time series forecasting models)

Financial time series models I

Description:
Financial Time Series Models. Econometric models: (linear) AutoRegressive Moving Averages models; (nonlinear) ARCH and GARCH. ML models: Feed forward (1-layer) Neural Networks (Nnet).
An introduction to Financial Fundamental Analysis (Graham and Dobb theory of investment)
Forecasting time series with Nnet and business fundamental indicators.

Financial time series models II

Description:
ML models II: LSTM, Gaussian processes (GP).
Forecasting financial time series with GP, Nnet, LSTM, with alternative data (e.g. News-based sentiment indicators). For this we shall review Sentiment Analysis and financial applications.

Algorithmic trading. Portfolio theory I

Description:
Algorithmic trading.
Portfolio optimization. Markowitz mean-variance model.

Portfolio theory II.

Description:
Factor models of returns with alternative data. Robust portfolio optimization. The Machine Learning portfolio

Optimization Heuristics in Finance

Description:
Heuristic optimization. Simulated Annealing (SA). Genetic Programming (GenP).
Applications: Calibrating GARCH models. Optimization of portfolios with computationally hard constraints (with SA).

Option pricing models I.

Description:
Options. Type of options (European, American, Asian and other). The Black-Scholes Formula for Valuing European Options (a brief review). Monte-Carlo valuation of options I.

Option pricing models II. Research directions.

Description:
Monte Carlo valuation of options II. Valuing options with Gaussian processes and other ML models. Other heuristics for valuing options. Review of further research topics in Machine Learning for Finance.

ACTIVITIES

Lectures

Specific objectives:
1, 2

Full-or-part-time: 75h
Theory classes: 26h
Self study: 49h

GRADING SYSTEM

No habrá examen escrito. La evaluación consistirá en dos trabajos para realizar en casa, que incluirán exploraciones en Python y ejercicios para complementar la teoría.

BIBLIOGRAPHY

Basic:
- Arratia, Argimiro. Computational finance : an introductory course with R. Atlantis Press, cop. 2014. ISBN 9789462390690.