

Année universitaire 2025/2026

# Research in Finance - 104 - 2nd year of master's degree

**Responsable pédagogique** : DELPHINE LAUTIER - <https://sites.google.com/site/delphinelaugierpageweb/>

**Crédits ECTS** : 60

## LES OBJECTIFS DE LA FORMATION

Research in Finance aims to give students an in-depth knowledge of finance in both theoretical and operational terms. It is entirely taught in English. With an education through research approach, it covers the main areas of finance: corporate finance, capital markets, derivatives valuation, portfolio management, quantitative tools, ... With the range of courses on offer, each student can create their own tailor-made study course.

### Skills acquired:

- Understanding the key variables of economics, finance and financial regulation;
- Analyzing the trends of financial markets;
- Understanding and applying economic and financial modelling;
- Building a critical mind and a scientific curiosity, in order to be able to collect pertinent financial information, create and manage databases, analyze academic literature;
- Reach the frontier of knowledge, ask the relevant questions and apply research methods with scientific scrutiny;
- Foster the autonomy in learning, in order to be able to write a Master's thesis (research or applied); in the case of an applied Master's thesis, a 3-months Internship is required.

## MODALITÉS D'ENSEIGNEMENT

The total teaching time is of 320 to 360 hours, from September to April. It is made of 36 hours of levelling courses in digital finance, corporate finance, financial econometrics and programming in Python and Matlab. The fundamental courses are taught mainly (but not only) during the first semester. They represent 150 hours, on corporate finance, mathematical finance, derivatives and asset pricing, management of fixed income, game theory, etc. The specialization seminars are devoted to topics like advanced corporate finance, behavioral finance, alternative finance, machine learning, regulation, etc. They represent 105 hours. In parallel with these courses, the student will have to write a Master's thesis in contemporary finance, and organize his personal work time. There are two possible options: the first is to write a research Master's thesis (this could be the first step towards a doctorate); the second is to write an applied Master's thesis. In this case it is mandatory to make a 3-months internship. The program gives students the opportunity to study in English, during the second semester, in one of the following institutions: there is one place at the Bocconi University every two years. There are two places per year at Tilburg University in the MSC "Research in Finance". Students interested in doing doctorate will take priority for these places. There are two places at Lugano University (English, Msc in finances or modules at the doctorate level), and two places at HEC Lausanne. Where the number of students wishing to study abroad exceeds the number of places available, priority will be given to those students who have already spent at least one year at Dauphine. Besides, the M2 104 belong to the QTEM network, which give the possibility to study one year abroad. Finally, the 104 offers, in the beginning of the year, some career coaching. It is also possible to obtain a certification by the French Authority of Financial Markets, and by the CFA.

## ADMISSIONS

- Students who have successfully completed the first year of a Master (240 ECTS or equivalent)
- Students from different study fields: management, economics, econometrics, mathematics, computer science, etc.
- For the students enrolled from the M1 Finance at Dauphine, it is recommended to follow a specific courses list, named as this program
- Knowledge in quantitative fields (applied mathematics, statistics, econometrics, computer science) is appreciated. A real interest for these topics is however highly recommended.
- The ability to provide Gmath and Toefl Scores is also valued.
- Autonomy, critical thinking and originality is appreciated

## POURSUITE D'ÉTUDES

This program can be extended by a doctoral thesis, especially for students having written a research Master's thesis. The

M2 104 is indeed the first step towards a PhD Thesis at Paris-Dauphine University or in another academic institution. In such case they will have to enroll in a doctoral program, to find a PhD supervisor and to find financial supports.

The best decision is often to choose the Professor for your Master's thesis who is likely to go on to become your doctoral thesis director. This way, the Professor knows your abilities and how to work with you

Several financial support schemes exist to help students depending on whether the doctorate is done at university, within a firm, with a research organization or abroad:

## PROGRAMME DE LA FORMATION

- Semester 3
  - LEVELLING COURSES - Select 2 courses
    - [Python for finance \(Bloc 1/3 of the Certificate "Fundamentals of Data Science"\)](#)
    - [Monte Carlo Simulations in finance - MathLab](#)
    - [Financial Econometrics I](#)
    - [Introduction to corporate finance](#)
  - FUNDAMENTAL COURSES - Select 4 courses for 24 ECTS (Option 1) or 5 courses for 30 ECTS (Option 2)
    - [Game theory](#)
    - [Term structures : theory, models and empirical tests](#)
    - [Finance in continuous time \(mandatory course, unless validated previously\)](#)
    - [Derivative Pricing and Stochastic calculus II \(prerequisite: finance in continuous time\)](#)
    - [Corporate finance \(prerequisite: introduction to corporate finance\)](#)
    - [Management of Credit Risk : Theory and applications](#)
    - [Asset pricing theory](#)
    - [Fixed income derivatives](#)
  - SEMINARS - Select 2 courses for 6 ECTS (Option 1) or 0 (Option 2)
    - [Machine Learning in Finance](#)
    - [Regulation and Financial Markets](#)
    - [Structured products in practice](#)
    - [Microeconomics for finance](#)
  - METHODOLOGY OF RESEARCH
    - [Frontiers in Finance](#)
- Semester 4
  - SEMINARS - Select 8 courses
    - [Microstructure of financial markets](#)
    - [Advanced corporate finance](#)
    - [Behavioral Finance](#)
    - [Advanced banking empirical finance](#)
    - [Empirical Asset Pricing \(it is strongly advised to have some knowledge in Python for this course\)](#)
    - [Advanced Market Microstructure](#)
    - [Time series \(it is strongly advised to have some knowledge in R for this course\)](#)
    - [Data management \(This course corresponds to the bloc 3/3 of the Certificate "Fundamentals of Data Science"\)](#)
    - [Machine Learning : empirical applications for finance \(prerequisite : Python for Finance\) \(This course corresponds to the bloc 2/3 of the Certificate "Fundamentals of Data Science"\)](#)
    - [Alternative Finance](#)
    - [Blockchains and Cryptocurrencies](#)
    - [Financial macroeconomics](#)
    - [Artificial Intelligence for finance](#)
  - METHODOLOGY OF RESEARCH AND MASTER'S THESIS - Select either "Short term Research Master's Thesis+Internship" (6 ECTS) or "Internship+Report " (6 ECTS) or "Long term Research Master's Thesis" (6 ECTS)
    - [Internship](#)
    - [Internship + Report](#)
    - [Methodology of research and Master's thesis. \(Includes a 6h Formation to R programming by Hassan Maatouk\)](#)

- [Short term Research Master's Thesis](#)
- [Long Term Research Master's Thesis](#)
- PROFESSIONAL TRAINING
  - [Formation Alumnye](#)
  - [AMF Certification \(On line course\)](#)
  - [AMF Certification on sustainable development \(on line course\)](#)

## DESCRIPTION DE CHAQUE ENSEIGNEMENT

### SEMESTER 3

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#### LEVELLING COURSES - Select 2 courses

## Python for finance (Bloc 1/3 of the Certificate "Fundamentals of Data Science")

**Langue du cours** : Anglais

#### Description du contenu de l'enseignement :

Our aim in this course is to implement some key concepts in quantitative finance using popular Python packages such as :

- NumPy : the fundamental package for scientific computing.
- Matplotlib : the main 2D plotting library.
- SciPy : another scientific computing library containing toolboxes dedicated to optimization, statistics and many other fields.
- Pandas : A library offering powerful data structures and tools for data analysis.

The data we will use is extracted from free online sources (Google, Yahoo, ...). The main parts of the course are the following :

1. Python basics : Data types, data structures, programs structure and packages.
2. Numpy, Matplotlib : discovering these packages with application to Monte Carlo simulation (look at the potential evolution of asset prices over time/Random walk).
3. Scipy : Introduction and application to a regression analysis of stock prices.
4. Pandas and Matplotlib. Introduction and Application (I) : importing, visualizing and analysing Time series financial data.
5. Pandas and Matplotlib. Advanced aspects and application (II) : Volatility calculation, Algorithmic trading, Creating, testing and improving a trading strategy.

#### Compétences à acquérir :

Mastering the structure of the Python language, a good knowledge of the most important libraries for financial applications (Numpy, Matplotlib, Scipy, Pandas).

#### Pré-requis obligatoires

Basics of algorithmics.

#### Mode de contrôle des connaissances :

Several programming assignments (one for each class).

**Coefficient** : 1

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## Monte Carlo Simulations in finance - MathLab

**Langue du cours** : Anglais

#### Description du contenu de l'enseignement :

**Lecture 1 and 2:** Introduction to MATLAB. Tutorial with numerical optimization of Rosenbrock's function and simulation of the Brownian Motion. Markowitz portfolio optimization.

**Lecture 3:** Binomial options pricing model. European, American, Butterfly and Barrier Knock - Out options. Simulation of a Binomial tree and assets trajectories.

**Lecture 4:** Black and Scholes Model. Monte-Carlo method for option valuation. European option. Correlated Brownian motions. Basket et Exchange options.

**Lecture 5:** Black and Scholes Model. Strongly Path-dependent options. Asian option. Lookback and Choosers. Stochastic volatility models. Euler-Maruyama approximation of Stochastic Differential Equations. Option and asset pricing in the Heston model.

**Lecture 6 and 7:** Merton Model. Poisson distribution. Simulation of assets trajectories with jumps. Option pricing in the Merton model.

**Compétences à acquérir :**

The students will learn important principles of implementation of financial models and master algorithms of evaluation of different types of derivative securities: European, American, standard, barrier and path dependent options on stocks. This course gives a comprehensive introduction to Monte Carlo and finite difference methods for pricing financial derivatives. At the end of the course, the student should have a thorough understanding of the theory behind Monte Carlo methods, be able to implement them for a range of applications, and have an appreciation of some of the current research areas.

**Pré-requis recommandés**

The notions of stochastic calculus, Black and Scholes models, Ito's formula.

**Mode de contrôle des connaissances :**

Control of Knowledge: Defense of a Project.

**Coefficient :** 1

**Bibliographie, lectures recommandées :**

Reading List: 1) S E Shreve, Stochastic Calculus for Finance II: Continuous-Time Models, Springer 2004. 2) P Glasserman, Monte Carlo Methods in Financial Engineering, Springer-Verlag, 2004. 3) P Wilmott, S D Howison and J Dewynne, Mathematics of Financial Derivatives, CUP, 1995.

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## Financial Econometrics I

**ECTS :** 3

**Enseignant responsable :** GAELLE LE FOL (<https://dauphine.psl.eu/recherche/cvtheque/le-foi-gaelle>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

This course is an introduction and/or refresher course in Econometrics that focuses on techniques for estimating regression models, on problems commonly encountered in estimating such models, and on interpreting the estimates. The goal is to provide participants with the basic skills and knowledge necessary to undertake empirical research and to prepare them to the advanced course in Econometrics of Financial Markets. If Gretl will be the econometric software used in the course, it is possible to use Python or R.

Course outline

- How to build an econometric model and how to use it?
- The (simple and multiple) linear regression model
- Inference, hypothesis testing and prediction
- Specification and diagnostic testing (heteroskedasticity, autocorrelation, model specification ...)
- Dealing with autocorrelation and heteroskedasticity
- Selection criteria, and model selection
- OLS Adaptation and beyond (outliers, dummies and piecewise regressions, revisiting explanatory variables)
- Alternative to OLS (2 Stage Least Squares, Maximum Likelihood, Generalized Least Squares, Quantile regression)

**Compétences à acquérir :**

Theoretical and practical knowledge of linear regression models estimation technics. Being able to set up an econometric analysis.

**Pré-requis obligatoires**

Mathematics and Statistics (bachelor level)

**Pré-requis recommandés**

First course in programming

**Bibliographie, lectures recommandées :**

- ADKINS L. C., [Using gretl for Principles of Econometrics](#), Version 1.041, August 2018, Free copy;
- BROOKS C., Introductory Econometrics for Finance, Second Edition, 2019, , 4th Edition, Cambridge University Press, 724 pages
- CARTER HILL R., W. E. GRIFFITHS and GUAY C. LIM, 2018, Principles of Econometrics, 5th Edition, John Wiley &

Sons, 912 pages

- GELMAN A., J. HILL and A. VENHTARI, 2021, Regression and Other Stories, 1st Edition, Cambridge University Press, 2021;
- GUJARATI D., Basic Econometrics, McGraw Hill Higher Education; 5th Revised edition edition, 2009

Pre-requisites:

- ANDERSON, D., D. SWEENEY, T. WILLIAMS, J. CAMM, and J. COCHRAN, 2019, Statistics for Business & Economics, 14th Edition, Cengage Learning, 1120 pages
- JACQUES, J., 2018, Mathematics for Economics and Business, 9th Edition, Pearson, 752 pages;
- LE FOL, G., 2022, [A \(Very\) Short introduction to Gretl using scripts](#), Mimeo, 6 pages

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## Introduction to corporate finance

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

**Context** This course is dedicated to students who have not studied the financial structure of the firm and practiced corporate finance. In that context, it presents the central place of valuation in finance and the usefulness of financial theory to deal with it properly.

**Table of contents**

Session 1: Introduction to the concept of value creation and financial analysis

Lecture: 3 hours

Definition and importance of corporate finance

Maximising shareholder value

Reading and interpreting financial statements

Analysis of financial ratios: liquidity, solvency, profitability

Session 2: Investment decision

Lecture: 3 hours

Analysis of investment projects: NPV, IRR, payback period

Investment portfolio management

Session 3: Financing decision 1/2

Lecture: 3 hours

Sources of financing: equity, debt and leverage effect

Cost of capital: cost of equity, cost of debt, weighted average cost of capital (WACC)

Session 4: Financing decision 2/2

Lecture: 3 hours

Optimal capital structure: Modigliani-Miller, Hamada theories

Session 5: Company valuation 1/2

Lecture: 3 hours

Valuation techniques: patrimonial approach, comparables method, Discounted Cash flow method (part 1)

Session 6: Company valuation 2/2

Lecture: 3 hours

Valuation technique: Discounted Cash flow method (part 2)

Structuring of a Leverage Buy Out

Session 7: Revision for the final exam

Lecture: 3 hours

Practical case studies

**Compétences à acquérir :**

- Understand the fundamentals of corporate finance and their practical application
- Develop skills in financial evaluation and financial resource management
- Analyse a company's investment and financing decisions
- Understand the concepts of financial risk management
- Study financial strategies for maximising shareholder value

#### **Pré-requis obligatoires**

As this is an introductory course for beginners and part of a curriculum that will include more advanced courses in the discipline, no pre-requisites are required.

#### **Pré-requis recommandés**

Fundamental notions in accounting : accrual accounting principle, double part, exercise concept

#### **Mode de contrôle des connaissances :**

Test after the last course (2 hours)

**Coefficient** : 1

#### **Bibliographie, lectures recommandées :**

Vernimmen P., Quiry, & Le Fur Y. (2025), *Corporate finance*, Wiley

Berk J. & DeMarzo P. (2020), *Corporate Finance*, Pearson

Brealey R. A., Myers, S. C. & Allen, F. (2017), *Principles of Corporate Finance*, Mc Graw Hill

**FUNDAMENTAL COURSES - Select 4 courses for 24 ECTS (Option 1) or 5 courses for 30 ECTS (Option 2)**

## **Game theory**

**ECTS** : 6

**Enseignant responsable** : DAVID **ETTINGER** (<https://dauphine.psl.eu/recherche/cvtheque/ettinger-david>)

**Langue du cours** : Anglais

#### **Description du contenu de l'enseignement :**

**Chapter 1: Normal form games:** pure and mixed strategy Nash equilibrium; weakly/strictly dominated strategies , iterated elimination of dominated strategies.

**Chapter 2: Dynamic games:** Backward induction, subgame perfect Nash equilibrium, repeated games.

**Chapter 3: Incomplete information (in static games):** Bayesian Nash equilibrium; introduction to some applications (auctions, finance...)

#### **Compétences à acquérir :**

The objective of the course is to give some fundamental background in interactive decision making and its applications. After having attended the classes, the students will be able to understand the basic tools of game theory and the importance of this field in economics and finance.

#### **Pré-requis obligatoires**

The student must be at ease with some basic mathematical notions such as: derivations, first-order conditions...

#### **Mode de contrôle des connaissances :**

A mid-term exam and a final exam

**Coefficient** : 1

## **Term structures : theory, models and empirical tests**

**ECTS** : 6

**Enseignant responsable** : DELPHINE **LAUTIER** (<https://sites.google.com/site/delphinelaugierpageweb/>)

**Langue du cours** : Anglais

### **Description du contenu de l'enseignement :**

The term structure is defined as the relationship between the spot price and the futures prices of a derivative instrument, for any delivery date. It provides useful information for hedging, arbitrage, investment and evaluation: it indeed synthesizes the information available in the market and the operators' expectations concerning the future price of the underlying asset.

In many derivative markets, especially in interest rates and in commodity markets, the concept of term structure is very important, because the contract's maturity increases as the markets come to fruition. In the US 3-months interest rate futures market, for example, the maturities reach 10 years. In this course, the commodity markets will be often taken as an example, to help understanding. Extensions to other assets will be done, as much as possible.

Chapter 1 presents a general introduction to derivatives today.

Chapter 2 examines the traditional theories of commodity prices and the explanation of the relationships between spot and futures prices. It proposes an empirical review of the results obtained through these frameworks and explains why these theories are still investigated today. It finally shows how to apply these theories to other assets: exchange rates and interest rates.

The traditional theories are however a bit limited when the whole term structure is considered. As a result, there is a need for a long-term extension of the analysis, which is the very subject of the Chapter 3. We first present a dynamic analysis of the term structure. Then the focus turns towards term structure models. The examples rely on the case commodity prices but can be extended to interest rates. Simulations highlight the influence of the assumptions concerning the stochastic process retained for the state variables and the number of state variables. We then explain the econometric method usually employed for the estimation of the parameters. In the presence of non-observable variables, there is a need for filtering techniques. We present the method of the Kalman filters. Finally, we study two main applications, i.e. dynamic hedging and investment valuation.

Chapter 4 is devoted to the study of structural models, ie micro-founded equilibrium models that also examine the interactions between the physical and the derivative markets. In this situation the spot price becomes endogenous. The interactions between prices are studied thanks to rational expectations equilibriums.

### **Compétences à acquérir :**

At the end of this course, the students must have a broad knowledge about the term structures of derivative prices: the theories, the valuation methods, the econometric techniques, the empirical tests as well as the applications.

They will also be trained to use their knowledge on this topic in order to develop a critical view on recent research articles.

This course is mandatory for all students enrolled in the cursus PhD Qualifying Year. It is optional for all other students of the M2 104.

### **Pré-requis recommandés**

Students who choose this course must also attend the course "Finance in continuous time"

### **Mode de contrôle des connaissances :**

Ongoing assessment, 20% One final exam, 80%.

**Coefficient :** 1

### **Bibliographie, lectures recommandées :**

- Danthine J.P., Donaldson J.B., Intermediate Financial Theory, 2d Ed., Elsevier, 2005. - Hull J., Options, futures and other derivatives, 9th Ed. - Kolb R.W. , Overdahl J.A. , Futures, options, and swaps, 5th Ed., Blackwell, 2007. - Williams J., The economic function of futures markets, Cambridge University Press, 1986 - Wilmott P., Paul Wilmott on Quantitative Finance, 3-volume set, 2nd Ed., Wiley, 2006. Adresse du site de l'enseignant

: <https://sites.google.com/site/delphinelaugierpageweb/>

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## **Finance in continuous time (mandatory course, unless validated previously)**

**ECTS :** 6

**Enseignant responsable :** RENE AID (<https://dauphine.psl.eu/recherche/cvtheque/aid-rene>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

Asset pricing, contingent claim, stochastic process, brownian motion, Itô's formula, optimal stopping time. This course is an introduction to "Derivative pricing and stochastic calculus II". It introduces the standard concepts and tools allowing to understand arbitrage theory in continuous-time. The requirements from probability theory are made as basic as possible to make the lectures accessible to students without a strong background in applied mathematics.

### Compétences à acquérir :

In the end of this course, the students must be comfortable with:

- i) Basic concepts of contingent claims,
- ii) the binomial model;
- iii) stochastic integrals and Itô's calculus;
- iv) the Black and Scholes model,
- v) Merton's optimal portfolio problem.

**Coefficient** : 1 (Master Finance)

3ECTS - Coefficient 1 (M2 Quantitative Economics)

### Bibliographie, lectures recommandées :

[Steven Shreve](#), Stochastic Calculus for Finance I: The Binomial Asset Pricing Model, 2005. [Steven Shreve](#), Stochastic Calculus for Finance II: Continuous-Time Models , 2005.

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## Derivative Pricing and Stochastic calculus II (prerequisite: finance in continuous time)

ECTS : 6

**Enseignant responsable** : JULIEN CLAISSE (<https://dauphine.psl.eu/recherche/cvtheque/claisse-julien>)

**Langue du cours** : Anglais

### Description du contenu de l'enseignement :

The aim of this lecture is to present the theory of derivative asset pricing as well as the main models and techniques used in practice. The lecture starts with discrete time models which can be viewed as a proxy for continuous settings. We then develop on the theory of continuous time models. We start with a general Itô-type framework and then specialize to different situations: Markovian models, constant volatility models, local and stochastic volatility models. For each of them, we discuss their calibration, and the valuation and the hedging of different types of options (plain Vanilla and barrier options, American options, options on realized variance,...).

Course outline:

#### I. Discrete time modelling

I.1. Financial assets I.2. The absence of arbitrage I.3. Pricing and hedging of European options I.4. Pricing and hedging of American options

#### II. Continuous time modelling

II.1. Financial assets as Itô processes II.2. The Black-Scholes model II.3. Markovian models in complete markets II.4. Local volatility models II.5. Stochastic volatility models

- General setting
- Tree markets
- Risk-neutral measures
- Fundamental theorem of asset pricing
- The super-hedging problem
- The complete market case : example of the CRR model
- Approximate hedging in incomplete markets
- Examples: binomial and trinomial tree markets
- The Itô process framework
- Discussion of the Absence of arbitrage opportunity
- Complete and incomplete markets
- The general pricing and hedging principle for European and American claims
- Characterization of complete Black Scholes markets

- Explicit formulas : European call option (Black-Scholes formula), barrier option (reflection principle)
- PDE valuation (plain vanilla, barrier, Asian, American options)
- Greeks and hedging
- Tracking error and convexity
- Dupire's formula and calibration to the volatility surface
- Super hedging prices
- Completion of the market with options : general principle, Approximate static hedging: example of the variance swap hedging problem
- Specific models : CEV, Heston, SABR,...

### Compétences à acquérir :

The lecture starts with discrete time models which can be viewed as a proxy for continuous settings, and for which we present in detail the theory of arbitrage pricing. We then develop on the theory of continuous time models. We start with a general Itô-type framework and then specialize to different situations: Markovian models, local and stochastic volatility models. For each of them, we discuss the valuation and the hedging of different types of options : plain Vanilla and barrier options, American options, options on realized variance, etc. Finally, we present several specific volatility models (Heston, CEV, SABR,...) and discuss their specificities.

### Pré-requis obligatoires

Students must have past Financial Derivatives and Derivative Pricing & Stochastic Calculus 1.

### Mode de contrôle des connaissances :

Final exam

### Bibliographie, lectures recommandées :

Bouchard B. et Chassagneux J.F., Fundamentals and advanced Techniques in derivatives hedging, Springer, 2016.  
Lamberton D. et B. Lapeyre, Introduction au calcul stochastique appliqué à la finance, Ellipses, Paris, 1999.

## Corporate finance (prerequisite: introduction to corporate finance)

ECTS : 6

**Enseignants** : EDITH GINGLINGER, LUC RENNEBOOG  
<https://dauphine.psl.eu/recherche/cvtheque/ginglinger-edith>

**Langue du cours** : Anglais

### Description du contenu de l'enseignement :

**Part 1. Prof. Laurent Frésard ([Laurent.fresard@usi.ch](mailto:Laurent.fresard@usi.ch))**

#### Course Objectives

The objective of this part of the “Corporate Finance” course is to introduce you to key topics in corporate finance through the lens of empirical research. Corporate finance is largely a non-experimental field with lots of data. The nature, scope, and detail of available data continue to expand rapidly. These data are used to generate empirical insights to validate or invalidate existing theories and constitute a basis for further theories. In this class, we will discover central topics and mechanisms in corporate finance by focusing on how researchers have used data and empirical methods to develop novel knowledge that is relevant for the practice of finance.

The overall approach in this class is to read and understand (selected) prior empirical work and replicate or extend some of these studies. The topics have been selected to make you work with specific datasets and methods. The primary expertise necessary is the understanding of how to use or manipulate datasets. You will need to appreciate the methods, approaches, and intuition of econometrics including and beyond a first graduate level of econometrics. I will cover some of the underlying approaches in class but our objectives will be different from those of an econometric course. Rather than a formal derivation of the underlying assumptions and tests, we will assess why something works the way it does.

#### Deliverables - Empirical exercises

You will have three exercise sets and a mini project to hand in. They are designed to get you up and running with financial datasets and empirical methods. There is a lot of work going into extracting databases and matching datasets. You should treat this as a permanent lifelong investment and the costs will seem more bearable. You will have to extract data from the relevant source, run the assigned tests, and answer to question I will specify. You will write a short report for each assignment, explaining all your steps and interpreting your results.

### Course outline and Readings

All chapters and articles marked with an \* should be carefully read in advance. As we will discuss these papers in class, not reading makes your attendance almost useless. I will ask questions related to these articles in class.

### Reading list for part 1. COURSE

**Identification and Causality Event studies Instrumental Variables Difference-in-Differences Regression Discontinuity Design Textual Analysis Part 2. Luc Renneboog**

### Part 2, Executive Remuneration Contracting

#### Compétences à acquérir :

The objective of this course is twofold: a. to introduce the student to state of the art econometrics applied in empirical corporate finance (e.g. to address endogeneity issues, to determine an identification strategy), b. to introduce the student to some important topics in theoretical corporate finance.

#### Pré-requis obligatoires

Introduction to corporate finance

#### Mode de contrôle des connaissances :

Part 1. The evaluation for the class consists of a project (45%) and a written final exam (55%).

Part 2. Written Exam (50%)

Coefficient : 1

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## Management of Credit Risk : Theory and applications

ECTS : 6

Enseignant responsable : OLIVIER TOUTAIN (<https://dauphine.psl.eu/recherche/cvtheque/toutain-olivier>)

Langue du cours : Anglais

#### Description du contenu de l'enseignement :

This course is an introduction to Credit Risk in its different dimensions (Default/Recovery/Transition), starting from a description of the phenomenology of Credit Risk, the different instruments subject to credit risk to the different modelling approach both for single name or portfolio exposure. Numerous concrete examples illustrate the concepts introduced and the mathematical model are studied through exercises. The aim is to cover the broad domain of credit risk from retail products (credit card, mortgages) to sovereign credit risk, looking at the existing practical issues that students would have to solve in their future employment either as Risk Managers, Traders, Asset Managers, Credit Risk Officer, Analysts, ...

A book covering the different concepts presented in class is made available and corrected exercise are also available to the students.

#### Compétences à acquérir :

The key concepts pertaining to credit risk should be understood by students and a solid framework would allow an easier analysis of credit risk and its management in their future job.

#### Pré-requis recommandés

Basic knowledge of fixed income products and interest rate notions.

Basic knowledge of probability / statistics is a plus (Theorem of Total Probability, Law of Large Number, Markov Chain, Univariate distributions)

#### Mode de contrôle des connaissances :

A final exam mixing (i) questions on topic seen during the class and (ii) quantitative exercises to measure credit risk.

Coefficient : 1

#### Bibliographie, lectures recommandées :

Credit Risk - Pricing, Measurement, and Management - Darrelle Duffie - Princeton University Press  
Credit Risk Modeling - David Lando  
Credit Risk - Tomasz Bielecki, Marek Rutkowski

# Asset pricing theory

ECTS : 3

Enseignant responsable : JEROME DUGAST (<https://dauphine.psl.eu/recherche/cvtheque/dugast-jerome>)

Langue du cours : Anglais

## Description du contenu de l'enseignement :

In this course, we will discuss a wide range of topics ranging from optimal portfolio, the CAPM, factor models, consumption-based asset pricing, and arbitrage pricing, to more special ones including asymmetric information, and limits to arbitrage.

1. Optimal Portfolio Theory and the CAPM
2. Factor Models
3. Decision Making under Uncertainty
4. Consumption-based Asset Pricing
5. Arbitrage Pricing
6. Dynamic Asset Pricing
7. Asymmetric Information and Asset Prices
8. Limits to Arbitrage

## Compétences à acquérir :

Master the theoretical concepts of asset pricing

## Mode de contrôle des connaissances :

Evaluation: assignment 20%, final exam 80%

Coefficient : 2

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# Fixed income derivatives

ECTS : 6

Enseignant responsable : AYMERIC KALIFE (<https://dauphine.psl.eu/recherche/cvtheque/kalife-aymeric-1>)

Langue du cours : Anglais

## Description du contenu de l'enseignement :

Interest rate derivatives, investment and hedging

The objective of the course is to give an all round comprehensive knowledge and understanding of the theory and the day-to-day use of interest rates derivatives, for both investment and hedging purposes.

Various views about the level and shape of the yield curve are implemented with selected absolute and relative value trades. across "Directional" and "Volatility" strategies.

Finally, this course introduces to the the sustainable investing landscape ("ESG") which has met some growing and significant appetite over the past decade, while providing insights and methodology for managing fixed income ESG investment strategies.

## Compétences à acquérir :

Participants will learn how banks, portfolio managers and corporate treasuries use rates derivatives alike in the management of risks, for trading, hedging and arbitrage and their role in the day-to-day running of the finances of businesses.

## Mode de contrôle des connaissances :

Take home exam: trade idea Table exam

Coefficient : 1

## Bibliographie, lectures recommandées :

**Fixed-Income Securities:** Valuation, Risk Management, and Portfolio Strategies, Lionel Martellini, Philippe Priaulet

**Fixed Income Analysis**, CFA institute, Barbara S. Petitt (Author), Jerald E. Pinto, Wendy L. Pirie, Bob

**Interest Rate Risk Modeling**, Wiley, Sanjay K. Nawalkha, Gloria M. Soto, Natalia A. Beliaeva **Fixed Income Mathematics**, Analytical & Statistical Techniques, Frank J. Fabozzi

SEMINARS - Select 2 courses for 6 ECTS (Option 1) or 0 (Option 2)

# Machine Learning in Finance

ECTS : 3

Enseignant responsable : PIERRE BRUGIERE (<https://sites.google.com/view/pierrebrugiere/home>)

Langue du cours : Anglais

## Description du contenu de l'enseignement :

- Introduction to statistical learning: The Vapnik Chervonenkis dimension, PAC learning and the calibration versus prediction paradigm.
- Primal and Dual Problem, Lagrangian and KKT conditions
- Supervised learning: SVM, Mercer's theorem and the kernel trick, C-SVMs, mu-SVMs, a few words on SVMs for regressions.
- Unsupervised learning: Single class SVMs, clustering, anomaly detection, equivalence of different approaches via duality.
- Introduction to random forests and ensemble methods: bias variance trade-off, bootstrap method
- Remarks on parsimony and penalisation: Ridge and Lasso regressions, dual interpretation of Lasso.

## Compétences à acquérir :

To understand the principles of supervised and unsupervised learning. Some Statistical Learning results are presented and applied to credit rating, anomalies detection and yield curves modelling. The principal notions are presented in the context of these case studies in finance.

## Pré-requis obligatoires

Basic linear algebra and differential calculus.

## Pré-requis recommandés

Basic linear algebra and differential calculus.

## Mode de contrôle des connaissances :

Exam

Coefficient : 1

## Bibliographie, lectures recommandées :

[1] James, Hastie, Witten, Tibshirani, Taylor; An introduction to Statistical Learning: file:  
[https://hastie.su.domains/ISLP/ISLP\\_website.pdf.download.html](https://hastie.su.domains/ISLP/ISLP_website.pdf.download.html)

[2] A Burkov; The hundred-pages machine learning book : chrome-extension://efaidnbmninnibpcajpcglclefindmkaj/http://ema.cri-info.cm/wp-content/uploads/2019/07/2019BurkovTheHundred-pageMachineLearning.pdf

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# Regulation and Financial Markets

ECTS : 3

Enseignant responsable : THIBAUT GODBILLON (<https://dauphine.psl.eu/recherche/cvtheque/godbillon-thibault>)

Langue du cours : Anglais

## Description du contenu de l'enseignement :

Banks, and the financial sector more broadly, operate in a highly regulated environment. Financial regulations have evolved over time, in response to key events, such as the 2008 Global Financial Crisis, emerging risks (e.g., data, cyber security, FinTech, etc) and more recently the COVID19 pandemic, or the failure of SVB and Credit Suisse. Regulations have broadened to encompass all parts of the financial system: banks and non-banks--insurers, market infrastructures, credit rating agencies, hedge funds, etc. Global policymakers (including BCBS, FSB, IOSCO) have developed international standards to support the G20 mandate--ensuring the stability and resiliency of the global financial system. At the local and regional level (in the EU for instance), prudential and market regulators are tasked with transposing these global standards in their own framework, which may cause some variations in the way regulations are implemented across jurisdictions. This lecture aims to provide students with an understanding of the global regulatory architecture,

ensure they understand where regulations come from, and how to stay up-to-date with a complex and constantly evolving topic. The course will also provide students with an overview of the current rules and regulations applying to banks and financial market operators in general. Via the drafting of a two-page note on a specific topic from the course, students will practice their written English communication and capacity to summarise complex matters. Finally, via the participation of experts from various background, the course will provide students with an insight into working for global organisations.

**Course outline:** 1) An introduction to financial regulations 2) Prudential regulations (Basel standards, CRD/CRR, DFA) 3) Crisis management (FSB standards, BRRD/CMDI, DFA) 4) Overview of Market regulations (International standards, MIFID/EMIR) 5) Sustainable Finance (Key risks, FSB/BCBS standards, EU taxonomy/GBS/ SFDR) 6) Digital Finance (Key risks, FSB/BCBS standards, DORA/MiCAR) 7) Outro (Wrap-up, critical considerations on financial regulations)

**Compétences à acquérir :**

Master the regulatory prudential and market reforms, at the global level and across regions

**Mode de contrôle des connaissances :**

Each students will be asked to prepare a two page note aimed at summarising a key issue of the programme.

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## Structured products in practice

ECTS : 3

**Enseignant responsable :** AYMERIC KALIFE (<https://dauphine.psl.eu/recherche/cvtheque/kalife-aymeric-1>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

Structured products, evaluation and control.

This course is an initiation to new structured products. It shows how to value such products, and how to control the associated risks

**Compétences à acquérir :**

Participants will learn how financial institutions can build and structured products, how they value them, and what they are done for.

**Coefficient :** 1

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## Microeconomics for finance

ECTS : 3

**Enseignant responsable :** JEROME DUGAST (<https://dauphine.psl.eu/recherche/cvtheque/dugast-jerome>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

**Syllabus:** 1. Equilibrium in an Exchange Economy 2. Decision Making under Uncertainty 3. Equilibrium in Markets for Securities 4. Investment Decision under Market Imperfections: the Principal-Agent Problem

**Compétences à acquérir :**

This 24 hours course aims at acquainting students with relevant microeconomics methods to tackle finance issues.

**Pré-requis recommandés**

Basic notions of mathematical analysis and algebra are required.

**Mode de contrôle des connaissances :**

Final exam and assignment

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### METHODOLOGY OF RESEARCH

## Frontiers in Finance

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

Content: This course is mandatory for the students enrolled in the cursus Phd Qualifying Year. It is optional for all others.

- Presentation of the research team and academic careers
- Presentation of the Dauphine PhD program in finance
- Series of seminars on topics situated at the frontiers of finance.

**Compétences à acquérir :**

The course Frontiers in Finance is a serie of seminars, proposed by academics of the university PSL Paris Dauphine. Most of them are members of the research team DRM-Finance.

The aim of this course is to present the different steps of an academic career (sessions 1 and 2) and to offer a view on recent researches in finance performed by the members of the team (all other sessions). This is an open view on what could be done after the M2 104, as well as on the state of the art in finance.

This course is mandatory for the students enrolled in the cursus Phd Qualifying Year. It is optional for all others.

**Mode de contrôle des connaissances :**

None

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**SEMESTER 4**

**SEMINARS - Select 8 courses**

## Microstructure of financial markets

ECTS : 3

**Enseignant responsable :** JEROME DUGAST (<https://dauphine.psl.eu/recherche/cvtheque/dugast-jerome>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

The field of market microstructure combines theoretical modeling, institutional knowledge, and empirical analysis to understand how prices result from the interactions of traders in financial markets. The course aims to acquaint students with (i) the canonical models in microstructure, and (ii) econometric models used to test the predictions of those models.

Course structure:

1. Trading Mechanisms
2. Measuring Liquidity
3. Price Dynamics and Liquidity
4. Trade Size and Market Depth
5. Empirical Analysis

**Compétences à acquérir :**

Master the concepts of financial markets microstructure

**Mode de contrôle des connaissances :**

Evaluation: assignment and final exam

**Coefficient :** 1

**Bibliographie, lectures recommandées :**

Foucault, Thierry, Marco Pagano, and Ailsa Röell, Market Liquidity: Theory, Evidence, and Policy, Oxford University Press, 2013.

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## Advanced corporate finance

ECTS : 3

**Enseignant responsable :** GILLES CHEMLA (<https://dauphine.psl.eu/recherche/cvtheque/chemla-gilles>)

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

Recent developments in the theory of corporate finance To follow this course, the students must validate the course "Corporate finance". Course objective : the main objective of the course is to familiarize students with a number of important, recent results and subjects that have been added to the theory of corporate finance. A second important objective is to provide an overview of some of the modelling issues faced and of the methods that are currently employed in the area of corporate finance

**Compétences à acquérir :**

The students will master the most recent reserach issues in corporate finance, with specific insights into modelling.

**Coefficient** : 1

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## Behavioral Finance

**ECTS** : 3

**Enseignant responsable** : ALBERTO MANCONI (<https://dauphine.psl.eu/recherche/cvtheque/manconi-alberto>)

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

Introduce students to this relatively new sub-discipline of finance which incorporates insights from cognitive and social psychology into finance. In the past 20 years behavioral finance has emerged as an important stream of thinking in finance. Relaxing the traditional assumptions of finance models has proved a fruitful way of understanding financial decision-making. Course outline: The course will go through:

- The cognitive biases evidenced by cognitive psychologists;
- Financial anomalies and their interpretations through a behavioral finance lens;
- The implications of behavioral finance for investors and corporate financial policy.

**Compétences à acquérir :**

Relaxing the traditional assumptions of finance models has proved a fruit ful way of understanding financial decision-making and anomalies found in empirical tests.

**Mode de contrôle des connaissances :**

Students will present a state-of-the art research paper among a selection of papers chosen by the instructors.

**Bibliographie, lectures recommandées :**

Daniel Kahneman, Paul Slovic, and Amos Tversky (eds.), Judgment under uncertainty: Heuristics and biases, Cambridge: Cambridge University Press, 1982. Richard Thaler, ed., Advances in behavioral finance, New York: Russell Sage Foundation, 1993. Richard Thaler, ed., Advances in behavioral finance, Volume II, New York: Russell Sage Foundation, 2005. Shleifer, Inefficient markets : an introduction to behavioral finance, Oxford, Oxford University Press 2000.

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## Advanced banking emperical finance

**ECTS** : 3

**Enseignant responsable** : Mattia GIROTTI (<https://drm.dauphine.fr/fr/drm/membres/detail-cv/profile/mattia-girotti.html>)

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

This is a practical course that leverages empirical corporate finance tools to analyze financial intermediation, and in particular, the access to credit of firms. The course is organized in chapters, each covering a specific aspect of banking. Each chapter discusses selected papers by placing attention on the data and the methodology employed.

Session Topic

- 1 Introduction to banking analysis
- 2 Borrower-lender relationship
- 3 Banking competition

- 4 Bank capital regulation
- 5 Bank funding
- 6 Crises and bank lending
- 7 Monetary policy and banks
- 8 Project Presentations

**Compétences à acquérir :**

By the end of the course, students will be able to empirically investigate research questions pertaining to banking. This includes collecting data, designing an empirical strategy, analyzing data with an econometric software (the course will focus on Stata), and organizing the results in both a paper and slides.

**Pré-requis obligatoires**

A good knowledge of corporate finance and econometrics is required.

**Mode de contrôle des connaissances :**

Presentation and discussion of academic papers in groups of maximum two people (40%) + Empirical project in groups of maximum two people (presentation 20%, written document 40%).

**Coefficient :** 1

**Bibliographie, lectures recommandées :**

Lecture notes are the main course material. In addition, these optional textbooks are recommended for this course:

- Degryse, Hans, Moshe Kim, and Steven Ongena, Microeconometrics of Banking: Methods, Applications, and Results. Oxford University Press, 2009.
- Roberts, Michael, and Toni Whited, Endogeneity in Empirical Corporate Finance, 2013.
- Angrist, Joshua D, and Jörn-Steffen Pischke, Mostly harmless econometrics: An empiricist's companion, Princeton University Press, 2009.
- Saunders, Anthony, Marcia Millon Cornett, and Otgo Erhemjamts, Financial institutions management: A risk management approach. McGraw-Hill, 2021.

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## Empirical Asset Pricing (it is strongly advised to have some knowledge in Python for this course)

**ECTS :** 3

**Enseignant responsable :** JUAN FELIPE IMBET JIMENEZ (<https://amandri.github.io/>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

The course will cover the necessary tools in order to conduct independent research in asset pricing, focusing on the relation between theoretical and empirical explanations of prices, and risk. Econometrics, equity returns, return predicability, discount factors, betas, mean-variance frontiers, GMM, testing asset pricing models, the cross-section of expected returns.

**Compétences à acquérir :**

Understanding of theory and empirics of asset pricing research, with a focus on how to bring models to the data.

**Pré-requis recommandés**

Econometrics, Asset Pricing Theory, Linear Algebra, and Macroeconomics

**Mode de contrôle des connaissances :**

Homeworks and Participation 30%

Final Exam 70%

**Coefficient :** 1

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# Advanced Market Microstructure

ECTS : 3

Enseignants : SABRINA BUTI, JEROME DUGAST, CAROLE GRESSE, FABRICE RIVA

<https://dauphine.psl.eu/recherche/cvtheque/dugast-jerome>

<https://www.marchesdetauxdinteret.fr/>

<https://dauphine.psl.eu/recherche/cvtheque/riva-fabrice>

Langue du cours : Anglais

## Description du contenu de l'enseignement :

1. Liquidity and Asset Prices
2. Limit Order Markets and OTC Markets: a Review of Theory
3. Market Transparency
4. Market Fragmentation
5. Algorithmic Trading and High-Frequency Trading
6. Microstructure and Corporate Finance
7. Information Technologies, Big Data, and Financial Markets

## Compétences à acquérir :

The course aims to acquaint students with advanced topics in market microstructure.

## Mode de contrôle des connaissances :

Referee reports or paper replications

Coefficient : 1

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## Time series (it is strongly advised to have some knowledge in R for this course)

ECTS : 3

Enseignant responsable : Yannick LE PEN ()

Langue du cours : Anglais

## Description du contenu de l'enseignement :

This course will present the modelling and forecasting of time series. We will expose the main concepts and methods applied to univariate time series : stationarity and unit roots, ARIMA models, univariate volatility models, forecasting. We will also present the methods for multivariate framework : VAR, Cointegration and VECM, Multivariate GARCH. The learning goal of this course is that students become able to engage in and conduct original research. It is also to prepare them to be professionals in careers that require training in econometrics. **Outline**

1. Univariate time series modelling and forecasting Stationarity and unit roots, unit root tests, ARIMA models : estimation, testing
2. Univariate volatility models ARCH, GARCH models and their extensions
3. Multivariate times series models VAR models, Causality, Impulse-Response analysis, Cointegration, VECM
4. Multivariate GARCH models BEKK, CCC and DCC models

**Software** The software that will be used in this course is R. No prior knowledge of this software package is assumed. This package will be introduced in lectures and in the problem sets as the course proceeds.

Students are asked to install R and RStudio Desktop :

1. R can be found on <https://pbil.univ-lyon1.fr/CRAN/>
2. RStudio Desktop can be found on <https://www.rstudio.com/products/rstudio/download/>

## Compétences à acquérir :

After this course, the students should be able to produce their own empirical study with time series. They also should have acquired sufficient knowledge to read and understand more complex time series econometric methods.

## Pré-requis obligatoires

The course assumes familiarity with statistics, probability and basic econometrics.

## Mode de contrôle des connaissances :

The grade is based on an individual project.

**Coefficient** : 1

## Bibliographie, lectures recommandées :

Brooks, C., *Introductory Econometrics for Finance*, Cambridge University Press, 3rd edition 2014.  
Ghysels, E. and M. Marcellino, *Advanced Economic Forecasting using Emerging Methods*, Oxford University Press, 2018.  
Mills, T., et R.N. Markellos, R.N., *The Econometric Modelling of Financial Markets*, Cambridge University Press ; 3ème Édition, 2008  
**Additional references** Campbell, J., A. Lo and C. MacKinlay, *The Econometrics of Financial Markets*, Princeton University Press, 1997  
Bauwens L., Hafner C. et S. Laurent, *Handbook of Volatility Models and the Real World*, John Wiley & Sons, 2012.  
Taylor, S. J., *Asset Price Dynamics: Volatility and Prediction*, Princeton University Press, 2007.  
Jondeau, E., Poon S.-H. et M. Rockinger, *Financial modeling under non-gaussian distributions*, Springer.  
Linton, O., *Financial Econometrics: Models and Methods*, Cambridge University Press, 2019

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# Data management (This course corresponds to the bloc 3/3 of the Certificate "Fundamentals of Data Science")

ECTS : 3

**Enseignant responsable** : BERTRAND HASSANI

**Langue du cours** : Anglais

## Description du contenu de l'enseignement :

Data science is an interdisciplinary field that is rapidly evolving. Many companies have widely adopted machine learning and artificial intelligence methods to power many applications that have captured the imagination of society at large. Data systems and data engineering are an inevitable part of all these large-scale data-driven applications and decisions, as ML/AI methods are powered by massive collections of potentially heterogeneous and messy datasets and, as such, should be managed as part of an organization's overall data lifecycle. This course corresponds to the third block of the Certificate "Fundamentals of Data Science". This Certificate is designed to train and familiarize professionals with the key technologies in this interdisciplinary field, with the aim of enabling them to take full advantage of the opportunities offered by data science and to become active players in this field within of their organizations. This is an accelerated training focused on the key modules of the profession of data scientist, in particular the management of massive data and machine learning.

**Course outline:**

- Module 1 : Why shall we engage a Data transformation program (1h)\***
  - Introduction
  - The Role of Data in a company
  - Review of the evolution of Data topics
  - Data value chain
  - Presentation of the pillars of a Data transformation (challenges / objectives)
  - The Data Strategy
  - Data Management & Governance
  - Analytics
  - IT
  - Project to Product team
- \*Module 2: Data Management (4h)\***
  - General presentation of the main concept of the framework (DAMA)
  - Structure & organization (roles & responsibilities)
  - Lineage & Metadata: data knowledge
  - The importance of data quality
  - Privacy / GDPR
  - Data types and their characteristics
  - Structured
  - Unstructured data
  - Examples of architectures
  - Main tools to manipulate Data
- \*Module 3: Case Analysis - From Theory to Practice: data retrieved from both a database and an excel file. (10h)\***
  - From integration to visualization
  - Integration of data from Excel file via Python
  - Representation, cleaning, recoding
  - Aggregates
  - Merge and join
  - **\*Practical work 1\***
  - Data integration from the database
  - Relational model
  - Introduction to SQL
  - SQL in Python
  - **\*Practical work 2\***
  - Beyond SQL, other possible cases (NoSQL)
  - Problems encountered when reconciling data (duplication, quality, veracity)
  - Can you put your trust into your data
  - **\*Practical work 3\***
  - Using Artificial Intelligence to explore to power of Data
  - Presentation of some use cases and explanation: how does that work practically ?

**Coefficient** : 1

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# Machine Learning : empirical applications for finance (prerequisite : Python for Finance) (This course corresponds to the bloc 2/3 of the Certificate "Fundamentals of Data Science")

**ECTS** : 3

**Enseignant responsable** : HOUCINE **SENOUSSI**

**Langue du cours** : Anglais

**Description du contenu de l'enseignement** :

### **Basics of ML**

- Definitions, approaches and applications.
- Data mining (DM) : definitions and links with ML.
- Classification and regression problems.
- Building and evaluating an ML model.
- Presentation of the main approaches of ML/DM.
- Application I.

### **Decision Trees** :

- Definitions and algorithms.
- Advanced methods based on DL : Bagging, Boosting and Random forests.
- Application II : Making a decision in finance.

### **Neural networks**:

- Definitions.
- Learning in NN : gradient descent and Backpropagation.
- Advanced methods based on NN (Deep learning).
- Application III : : Stock pricing.

### **Reinforcement Learning** :

- Definitions : Agents and environments.
- Markovian Decision Process (MDP).
- Policies and optimal policies.
- Q-learning.
- Application IV : Trading.

### **Compétences à acquérir** :

Building Machine Learning (ML) models for Finance problems. Using ML Python library (and in particular sickit-learn).

### **Pré-requis obligatoires**

Python programming language.

### **Mode de contrôle des connaissances** :

Two/Three assignments (building a model + Python programming).

**Coefficient** : 1

## **Alternative Finance**

**ECTS** : 3

**Enseignants** : FABIAN **ASTIC**, MARIUS **FRUNZA**

<https://dauphine.psl.eu/recherche/cvtheque/astic-fabian>

**Langue du cours** : Anglais

**Description du contenu de l'enseignement** :

The aim of this course is to propose an out-of the box perspective upon the financial markets and to explore the financial universe beyond the traditional investments like equity, bonds, currency... . We will focus the course on the products and technics used at the fringe of finance including crowdfunding, peer-2-peer finance, shadow banking, Bitcoin, social and environmental impact products.... Throughout this course students will learn about alternative investment supports and alternative financing solutions. The objectives of this lecture are:

- To understand the mechanism of alternative risks: global warming, catastrophic events including on the economy, ...
- To explore new area including Environmental, Social, and Governance (ESG) Investment, cryptocurrency etc..

- To get familiar with modelling methods specific to alternative finance.

Course outline: 1. Alternative finance 101 Two faces of the same coin: as investors or as issuers. 2. Modelling methods for alternative finance

- Introduction to the non-Gaussian universe
- Real Option Theory
- Extreme value theory

3. Crypto-currencies: an alternative financial universe 4. Environmental, Social, and Governance (ESG) Investment 5. Crypto-currency : an alternative financial universe. 6. Alternative capital markets and Fintechs: Focus on Crowdfunding and P2P finance 7. Alternative Risk Transfer

- Climate risks
- Insurance and re-insurance. Focus on CAT Bonds

8. Fintech workshop (industry view)

### Compétences à acquérir :

Knowledge on the modelling methods specific to alternative finance.

### Pré-requis obligatoires

Students must be enrolled in courses Applied Time series and must have past Introduction to Financial Econometrics, Financial Derivatives.

### Mode de contrôle des connaissances :

Project

Coefficient : 1.5

### Bibliographie, lectures recommandées :

- Alexandridis, A. K. and A. D. Zaprakis, 2013: Weather Derivatives, Springer, 300 pages.
- Barriau P., and L. Albertini, 2009: The Handbook of Insurance-Linked Securities, Wiley, 398 pages.
- Frunza, M., 2010: Carbon allowances: A new financial asset, Editions universitaires europeennes, 164 pages.
- Guthrie G., Real Options in Theory and Practice, 2009, OUP, 432 pages.

## Blockchains and Cryptocurrencies

ECTS : 3

Enseignant responsable : LOUIS BERTUCCI (<https://dauphine.psl.eu/recherche/cvtheque/bertucci-louis>)

Langue du cours : Anglais

### Description du contenu de l'enseignement :

Although blockchain technology is a fairly recent concept, the rate of innovation in this space has been tremendous over the past years. This class will give students an overview of the fundamental concepts needed to properly understand most aspects around blockchains, with a focus on the Bitcoin and Ethereum blockchains. We will also cover the most recent advanced topics including : Consensus Algorithms (Proof-of-Work vs Proof-of-Stake), the scaling problem, Smart contracts as well as a detailed approach of Decentralized Finance (DeFi), Token economics (Fungible and Non-Fungible Tokens) and CDBC. The academic literature is also very dynamic and this class will heavily rely on this literature to explain in depth the main concepts. Although an academic approach will help students get a solid knowledge about blockchains, this class will also incorporate some practical training, including low-level bitcoin transaction scripting and smart contract development/deployment/interaction with Solidity. Even if this class is not directed to computer scientists, students will be expected to make the effort to learn about the most important computer science primitives needed to understand the economics of blockchain. Such primitives will be taught in class.

### Compétences à acquérir :

Students are expected to get an in-depth understanding of the functioning of any blockchain and DeFi projects, as well as an awareness of most of the current important issues and recent developments. Students will also be exposed to the most important papers in the literature as well as some knowledge on practical aspects like the basics of smart contract development. Students are not expected to become smart contract developers but rather to know the basics of it, how it works and ultimately to be able to interact with actual smart contract developers.

### Pré-requis obligatoires

Coding skills : Python development. Some knowledge in Javascript will also be a plus as Solidity, the most popular smart-

contract development language, has a Javascript-like syntax, but this is not mandatory.

Knowledge in basic economics and Game Theory will also be a plus although not mandatory.

**Mode de contrôle des connaissances :**

Oral presentation (critical assessment of a chosen blockchain or DeFi project), Homework (coding, paper review) and/or final exam.

**Coefficient :** 1

**Bibliographie, lectures recommandées :**

Books :

- Andreas Antonopoulos, Mastering Bitcoin, 2nd edition, O'Reilly, 2017
- Andreas Antonopoulos, Gavin Wood, Mastering Ethereum, 1st edition, 2018
- Primavera De Filippi, Aaron Wright, Blockchain and the Law : The Rule of Code, Harvard University Press, 2018
- Campbell Harvey, Ashwin Ramachandran, Joey Santoro, DeFi and the Future of Finance, 1st edition, Wiley, 2021

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## Financial macroeconomics

**ECTS :** 3

**Enseignant responsable :** VERONIKA SELEZNEVA (<https://sites.google.com/view/veronikaselezneva/home>)

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

Course outline (tentative)

1. Deterministic dynamic optimization problems.
  - a. Firm's hiring decision
  - b. Consumption & Savings Under Uncertainty
  - c. Theory of Investment
2. Asset pricing and risk.
  - a. Equity premium puzzle
3. Monetary economics.
  - a. Introducing money. Classical issues in monetary economics.
  - b. Introducing price setting. Monetary economics with frictions.
  - c. Monetary policy.

**Compétences à acquérir :**

This course studies the theoretical foundations of modern macroeconomics. The goal of the course is to develop intuition that can help us understand the dynamics of key macroeconomic variables and use formal models to derive policy implications. The students will be provided with the mathematical tools used in constructing dynamic stochastic general equilibrium models.

**Pré-requis obligatoires**

Intermediate macroeconomics and calculus.

**Mode de contrôle des connaissances :**

The grades will be determined as follows: homeworks, 10%; final project, together with its presentation, 90%.

**Bibliographie, lectures recommandées :**

The textbooks for the course are:

- Stokey, Nancy L., Robert E. Lucas, Jr., and Edward C. Prescott: Recursive Methods in Economic Dynamics. Cambridge: Harvard University Press, 1989.
- Ljungquist, Lars and Thomas J. Sargent: Recursive Macroeconomic Theory. Second Edition. MIT Press. 2004.
- Galí, Jordi. Monetary Policy, Inflation, and the Business Cycle: an Introduction to the New Keynesian Framework.

Princeton University Press, 2008

- Cochrane, John H. Asset Pricing:(Revised Edition). Princeton university press, 2005.

Additional reading materials and the related readings will be made available later.

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## Artificial Intelligence for finance

**ECTS** : 3

**Enseignants** : BERTRAND HASSANI, HOUCINE SENOUSI

**Langue du cours** : Anglais

**Coefficient** : 1

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**METHODOLOGY OF RESEARCH AND MASTER'S THESIS - Select either "Short term Research Master"s Thesis+Internship" (6 ECTS) or "Internship+Report " (6 ECTS) or "Long term Research Master's Thesis" (6 ECTS)**

## Internship

**ECTS** : 3

**Enseignant responsable** : DELPHINE LAUTIER (<https://sites.google.com/site/delphinelaugierpageweb/>)

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

The M2 104 Research in Finance receives a wealth of internship offers from companies and past Master's students, which helps students find the right internship every year. During the year, several meetings are organized with large financial institutions. The 104 also benefits from its large network of Alumniees and its linkedin group.

**Compétences à acquérir :**

The students of the M2 104 Research in Finance who are interested in a career in the finance industry can choose the short-term research option, that includes an short-term research master's thesis plus an internship.

The subject of the internship can be related to the subject of the Master's thesis, but it is not mandatory.

The length of the internship is a minimum of 3 months. Most of the time, it lasts 6 months or more.

The internship can not start before the end of the courses. Most of the time it starts in April and is carried out in a financial institution or in the finance department of a firm. The internship must be finished around mi December (the precise date is given every year by the administration).

**Mode de contrôle des connaissances :**

The internship is validated by D. Lautier. Its subject must be in line with the knowledge acquired by the students during the year.

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## Internship + Report

**ECTS** : 6

**Enseignant responsable** : DELPHINE LAUTIER (<https://sites.google.com/site/delphinelaugierpageweb/>)

**Langue du cours** : Anglais

**Description du contenu de l'enseignement :**

Students are required to write a Master's thesis on an innovative topic, which enables them to gain true expertise on their subject.

**Compétences à acquérir :**

The long-term research Master's thesis is designed for the students who wish to pursue a career in research after the M2 104. This carrer in research can envisioned in a private firm or by applying to a PhD program in Finance (at Dauphine, or in another academic institution).

The long-term master's thesis is also an opportunity to meet a thesis director who might become the supervisor of the PhD thesis at Dauphine PSL

Writing a long-term research Master's thesis is mandatory for all students enrolled in the PhD Qualifying Year. All other students can choose either a long-term Master's thesis or the combination of a short-term research Master's thesis and an internship.

When a student chooses the long-term research master's thesis, there is no need, for him ou her, to do an internship. There are, however, some possibilities to do a 2-months research internship in the research lab. DRM-Finance.

**Mode de contrôle des connaissances :**

The research long-term master's thesis is graded by the supervisor of the research .This supervisor should receive the thesis in the beginning of September. The defense of the thesis occurs before the 15th of September.

In addition, when a student wants to enrol in the PhD program in finance of PSL - University Paris Dauphine, he/she need to write a research project with the person who intend to supervise the PhD. This project is due in May.

**Coefficient :** 4

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## **Methodology of research and Master's thesis. (Includes a 6h Formation to R programming by Hassan Maatouk)**

**Langue du cours :** Anglais

**Description du contenu de l'enseignement :**

In this seminar, the students will learn:

- to define a research subject;
- to select, read and use the articles related to their subject
- to organize the content of their Master's thesis, and to write their review of the litterature.

**Compétences à acquérir :**

This course is an introduction to the methodology of research focused on the writing of a Master's thesis. Throughout the year, the students of the M2 104 have to work on their master's thesis, which is a very important part of their formation.

The aim of the Master's thesis is to produce an original piece of research work on a clearly defined topic within the investigative field of contemporary finance, under the guidance of one of the Masters' Professors.

- For students considering a career in the industry, the Master's thesis is a unique opportunity to demonstrate their scientific expertise in the field of finance and experience shows that employers highly value this research approach. In this case, the students work on a short-term master's thesis, up to July. In addition, they must find an internship.

- For students considering a doctoral thesis, the Master's thesis enables them to get an initial feel for what research involves and is often the foundation for further investigation for a student's doctorate. In this case, the students work on a long-term master's thesis, up to September. They do not have to find an internsip.

**Mode de contrôle des connaissances :**

The seminar is mandatory for all students of the M2 104. Their grades depend on the assiduity of the student and his /her ability to produce in due time, five documents. Each document represents one step in the writing of the Master's thesis.

Document n°1 reveals the preferences of the students about the research subjects in which they are especially interested

Document n°2 gives a definition of the subject, in accordance with the supervisor of the Master's thesis

Document n°3 is a synthesis about the main references that will be needed to write the Master's thesis

Document n°4 is a first draft of the review of the litterature

Document n°5 is the Master's thesis

**Coefficient :** 4

**Bibliographie, lectures recommandées :**

Adresse du site de l'enseignant : <https://sites.google.com/site/delphinelaugierpageweb/>

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## **Short term Research Master's Thesis**

**ECTS :** 3

**Langue du cours** : Français

**Description du contenu de l'enseignement :**

The Short-term Master's thesis is partly prepared during the course on research methodology, but most of the work is done under the supervision of Professor of the team.

The purpose of the Short-term Master's thesis is, for the student:

- to anchor an autonomy in learning
- to enhance his or her capacity for innovation
- to provide education through research
- to write an original piece of work, on contemporary questions

The interest of such a work, for the student, is to acquire a distinctive competence on a specific subject. This specific skill should be an asset for her or his professional career.

**Compétences à acquérir :**

The aim of the Short-term Research Master's thesis is to produce an original piece of research work on a clearly defined topic within the investigative field of contemporary finance, under the guidance of one of the Master's Professors.

The Short-term Master's thesis is a tool for the students of the M2 104 who intend to find a position in the finance industry. It is a unique opportunity to demonstrate their scientific expertise in the field of finance. Experience shows that employers highly value this research approach.

**Mode de contrôle des connaissances :**

The Short-term master's thesis must be sent to the supervisor by the End of June, and defended before mid-July. Part of the grade is linked to the assiduity and the quality of the documents realized by the student during the course on research methodology.

**Coefficient** : 4

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## Long Term Research Master's Thesis

**ECTS** : 6

**Langue du cours** : Français

**Description du contenu de l'enseignement :**

The long-term master's thesis is partly prepared during the course on research methodology, but most of the work is done under the supervision of a Professor of the team.

The purpose of the Long term Master's thesis is, for the student:

- to anchor an autonomy in learning
- to enhance his or her capacity for innovation
- to provide education through research
- to write an original piece of work, on contemporary questions

**Compétences à acquérir :**

The Long term Master's thesis is designed for the students who wish to pursue a career in research after the M2 104, for example by applying to the PhD program in Finance of the University PSL Paris Dauphine.

Students are required to write a Master's thesis on an innovative topic, which enables them to gain true expertise on their subject. The long term master's thesis also gives the opportunity to meet a thesis director who might become the supervisor of the PhD thesis.

**Mode de contrôle des connaissances :**

The thesis supervisor should receive the long-term master's thesis in the beginning of September. The defense of the thesis must occur before the 15th of September. When a student chooses the long term master's thesis, there is no need, for them, to do an internship. There are however, a few possibilities to do a 2-months research internship in the research team DRM-Finance.

**Coefficient** : 4

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# Formation Alumnye

**Langue du cours :** Anglais

## **Description du contenu de l'enseignement :**

This short-term course is a professional formation proposed by the society AlumnEye. It is scheduled in the very beginning of the year, in September. It offers a coaching to the students who intend to pursue in the finance industry after the M2 104 Research in Finance, especially those considering an international career, and who are willing to prepare themselves to the recruiting processes and the professional interviews in the fields of banking, finance and consulting.

The fees that the students must pay to attend this formation are offered by the University. The number of places is limited to those really interested in this formation.

## **Compétences à acquérir :**

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## AMF Certification (On line course)

**Langue du cours :** Anglais

## **Description du contenu de l'enseignement :**

Content of the certification: - Know the general principles of banking and financial law - Identify the role and operation of the various financial actors - State the main principles of French financial regulation - Master the fundamentals of the monetary and financial code and the general regulations of the AMF - Understand and explain the rules on client protection and the legal and ethical framework governing financial transactions, - Know the different means of payment and describe their main characteristics: cards, checks, transfers, direct debits. - Inform a client about the different types of financial instruments - Distinguish the different types of financial instruments used by customer - Know the organization and role of financial markets - Ability to read business financial statements - Get an overview of tax rules for businesses and individuals

## **Compétences à acquérir :**

The AMF General Regulation requires investment services providers to verify that persons exercising certain functions under their authority or on their behalf have a minimum level of knowledge in 12 areas relating to the regulatory and ethical environment and financial techniques.

The AMF Certification is an online course proposed by an institution certified by the AMF. The M2 104 Research in Finance gives to some students the possibility to follow it and to validate the exam, during the second semester. The fees of the Certification are offered to the 5 students who obtained the highest grades during the 1st Semester.

## **Mode de contrôle des connaissances :**

One line examination / On site examination, at Dauphine, when possible

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## AMF Certification on sustainable development (on line course)

**Langue du cours :** Anglais

## **Description du contenu de l'enseignement :**

The AMF Sustainable Finance examination consists of 60 multiple-choice questions (MCQs) and can only be administered by one of the AMF-certified organisations listed below. The pass mark is 80%.

The knowledge test lasts a maximum of one hour and a half on the following topics:

- Sustainable Finance and main concepts;
- The French and European regulatory framework;
- Companies and non financial actors: environmental, social and governance issues;
- Extra-financial approaches in the field of asset management;
- Marketing of Sustainable Finance products.

## **Compétences à acquérir :**

The AMF Sustainable Finance examination is aimed in particular at sales professionals who wish to acquire a general

understanding of the regulatory and economic framework governing sustainable finance. It enables them to understand the essential concepts and to acquire a frame of reference for the products and methodologies used, so that they can identify their clients' sustainability preferences and thus offer them products tailored to their needs.

**Mode de contrôle des connaissances :**

On line examination

En savoir plus sur le cours : [https://www.amf-france.org/en/news-publications/depth/amf-examination#AMF\\_Sustainable\\_Finance\\_examination](https://www.amf-france.org/en/news-publications/depth/amf-examination#AMF_Sustainable_Finance_examination)

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