University Paris Dauphine - PSL

Master Quantitative Economics

First year

Compendium of syllabus

Academic year 2025-2026

<u>Common warning about academic integrity</u>
Be aware of the rules in Université Paris- Dauphine about plagiarism and cheating during exams. All work turned in for this course must be your own work, or that of your own group. Working as part of a group implies that you are an active participant and fully contributed to the output produced by that group. When you use the web, please state your sources.

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Table des matières

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Overview of the curriculum

Course	Hours	Tutorial	ECTS / VAL	Weighting coefficient
Master 1, Semester 1				
Up-grade courses (3 ECTS) - End August/Early September				
Upgrade in statistical tools	15		3	0,5
Introduction to Matlab programming		12	VAL	0
Fundamental mandatory courses (27 ECTS)- September-December				
Microeconomic Theory	36		6	1
Economics of growth	36		6	1
Game Theory	36		6	1
Data Management and programming	36		3	1
Macroeconometrics	24	12	6	1
Master 1, Semester 2: Choose your Major				
Course	**Hours**		**ECTS**	
Major Economics (27 ECTS)				
Mandatory (24 ECTS)				
Public Economics	30		6	1
Industrial Organization	30		6	1
Applied Microeconometrics	30		6	1
Microeconometrics: Data applications		24	3	1
Elective (6 ECTS to validate)				
Business cycles analysis	24		3	0,5
Population Economics	24		3	0,5
Topics in Advanced Industrial Organisation	21		3	0,5
Measurement issues with applications to GDP, poverty and inequality	21		3	0,5
Major Data (27 ECTS)				
Mandatory (21 ECTS)				
Industrial Organization	30		6	1
Topics in Advanced Industrial Organisation	21		3	0,5
Optimization and numerical methods	24		6	1
Unsupervised learning	18		3	0,5
Programming and web data collection	18		3	0,5
Elective (6 ECTS to validate)				
Microeconometrics	30		6	1
Business cycles analysis	24		3	0,5
Population Economics	24		3	0,5
Open your mind (3 ECTS)				
Topics in advanced economic analysis	21		3	0,5

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Semester 1 courses

All semester 1 courses are mandatory

Upgrade in statistical tools

Professor: Eric Bonsang, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information :
Eric Bonsang: eric.bonsang@dauphine.psl.eu

Information on the course :
Master 1, Semester 1
Course load: 15h, 5 sessions (3 hours per session)
ECTS: 3

Overview:
The course will first review the fundamentals of probability, followed by the fundamentals of mathematical statistics beginning with the properties of random samples and statistical inference involving estimation and hypothesis testing. The course will also introduce the simple regression model.

Prerequisites
The course is taught for students who do not have a strong background in statistics and econometrics. However, knowledge of basic mathematical tools is necessary to follow the course.

Course Objectives:
The objective of the course is to provide students the fundamental techniques of statistics, which are necessary to command for subsequent courses in Econometrics.

After having attended the classes, the students are expected to understand:
- The concept of random variables and their probability distributions
- The concept of random sampling, the finite sample and asymptotic properties of estimators
- The basics of hypothesis testing
- The definition and the properties of the simple regression model

Mode of Assessment
100 % Final written exam

Planning / Course Schedule

1	The concept of random variables and their probability distributions
2	The concept of random sampling, the finite sample and asymptotic properties of estimators

3	General approaches to parameter estimation
4	Hypothesis testing
5	The definition and the properties of the simple regression model

Readings
Introductory Econometrics. A Modern Approach. Jeffrey Wooldridge.

Access to the educational support
This course is on Moodle : **Yes**

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: Active class participation – this is what makes classes lively and instructive. Come on time and prepared.

Exam policy: In the exam, students will not be allowed to bring any document (except if allowed by the lecturer). Unexcused absences from exams or failure to submit cases will result in zero grades in the calculation of numerical averages. Exams are collected at the end of examination periods.

Introduction to Matlab programming

Instructor : Julia Schmidt, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information : julia.schmidt@dauphine.psl.eu

Information on the course :

Master 1, Semester 1
Course load: 12h, 4 sessions of 3 hours per session, over 2 weeks
ECTS :
- 0 ECTS for the Master 1 in Quantitative Economics;
- 3 ECTS for the "Advanced Quantitative Methods in Economics" Certificate, delivered by the PSL Graduate Program in Economics

Attendance in class is mandatory to all Master 1 students. Every absence must be duly justified.

Overview:
This an intensive crash course introducing the basics of MATLAB programming. MATLAB (the name stands for: Matrix Laboratory) is a high-performance programming language and a computing environment that uses vectors and matrices as one of its basic data types (MATLAB is a registered trademark of the MathWorks, Inc.). It is a powerful tool for mathematical and technical calculations, and it can also be used for creating various types of plots.

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Prerequisites
There is no prerequisite.

Course Objectives:

The first set of lectures are devoted to the introduction of standard programming such as mathematical operations, matrix creation and manipulation. The course then focuses on coding of loops and conditional statements. Next, the course introduces the concept of functions. The course ends with a presentation of optimization methods and solvers.

Course Schedule

1	Introduction to MATLAB programming: - Installation and presentation of the commands - Manipulation of vectors, matrices, and mathematical operations
2	Creation of plots: - Plot 2D and 3D graphics - Present and exports graphs from MATLAB
3	Conditional statements and loops: - Understand and implement conditional statements - Code loops
4	Functions: - Create functions with multiple input arguments or/and multiple output variables - Introduction to optimization methods

Readings : The course is based on the material Gauthier Vermandel for his lecture "Introduction to Finance with MATLAB".

Moodle
Pedagogical supports (slides and other materials) will be available through Moodle: **Yes**

Grading
Class participation: Encouraged

Exam policy:
No exam.

Microeconomic Theory

Professor: Claire Rimbaud, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information: claire.rimbaud@dauphine.psl.eu

Information on the course
Master Quantitative Economics, First Year, Semester 1
Course load: 36h (12 sessions of 3 hours)
ECTS: 3

Overview

This is an advanced microeconomics course. The objective of the course is to provide a comprehensive exposition of modern economic theory on the way consumers and firms make their consumption and production decisions in a competitive economy and on how prices are determined in the market (partial equilibrium). The iinteractions between markets will also be studied (general equilibrium). It will cover some concepts of welfare economics (e.g., Pareto efficiency) and publics economics (e.g. externalities, public goods).

Beginning at an intermediate level, the course will present a formalized exposition of the concepts, preparing students for a more advanced doctoral course.

Prerequisites

Maths (linear algebra and optimization problems)

Course Schedule (11 course weeks + 1 midterm week)

Week	Topic
W1 + W2	Consumer Theory
W3 + W4	Producer Theory
W5 + W6	General Equilibrium
W7 + W8	Pareto Efficiency
W9 + W10 + W11	Externalities and Public Goods

Readings

- Hugh Gravelle and Ray Rees, "Microeconomics", 2004, 3rd Edition, FT Prentice Hall
- H. Varian, "Microeconomic Analysis", Norton & Company, Inc., 3rd edition, 1992

Access to the educational support

This course is on Moodle : **Yes**

Grading

The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

- Midterm: 50% of the final grade – written exam in class
- Final Exam: 50% of the final grade – written exam in class
- Bonus: 0 to 2 bonus points on the final exam – randomly collected homework

Economics of growth

Professor: Anne Epaulard, Université Paris-Dauphine – PSL, LEDa

Contact Information: Anne.epaulard@dauphine.psl.eu

Information on the course:

Master 1, Semester 1
Course load: 36 hours, 12 sessions, 3 hours each
ECTS : 6

Overview:
The course presents the main growth models (neoclassical Solow - Ramsey model, endogenous growth models (Romer (1989) and Aghion and Howitt (1990) including those with endogenous technical progress Acemoglu (2012)).
Emphasis is on how these models help understand medium-term changes in the structure of economies and analyze the impact of the demographic slowdown and energy transition.
Students learn how to solve these models either analytically or numerically.

Prerequisites:
Mathematics & optimisation

Course Objectives:
The course will provide students with sound knowledge and understanding of the basis of modern macroeconomic theory regarding long run economic growth. After attending the classes, the students will master the fundamental models of modern macroeconomics in view of analysing the key issues relative to long run economic growth and public policies to support growth (innovation) and to face the challenges of demographic slowdown and energy transition. They will also get familiar with solving these models analytically or numerically.

Course Schedule:
The course will cover the following topics.
1. Stylized facts about long run growth – Growth decomposition and the Solow residual
2. The impact of growth on economic welfare
3. The Solow model and conditional economic convergence
4. The Ramsey model
5. Externalities and the AK growth model; the role for tax policy
6. R&D, innovation and growth (Romer (1990) model)
7. Growth in creation / destruction models (Aghion – Howitt model)
8. Growth with directed technical change
9. Sustainable growth and energy transition analysis
10. Economic growth and declining population

Readings:

- <u>Reference book</u>: Aghion, Philippe and Howitt, Peter "*The Economic of Growth*", MIT Press 2008
- Daron Acemoglu, 2002. "Directed Technical Change." *Review of Economic Studies* 69(4): 781–809.
- Daron Acemoglu, Philippe Aghion, Leonardo Bursztyn, and David Hemous, 2012,"The Environment and Directed Technical Chang", *American Economic Review 2012, 102(1): 131–166*
- Charles I. Jones and Peter J. Klenow (2016) "Beyond GDP? Welfare across Countries and Time", *American Economic Review*, 2016, 106(9): 2426-2457
- Charles Jones (2022) "The end of economic growth? Unintended consequences of a declining population, *American Economic Review, 2022, 112(11): 3489-3527*

Access to the educational support
This course is on Moodle : **Yes**

Grading:
60% of the final grade is based on a final exam (closed book exam).
40% is based on regular short quizzes.
Participation in class will be considered as bonus over this grade.

Class participation: Active class participation – this is what makes classes lively and instructive. Come on time and prepared.

Exam policy: In the final written exam, students will not be allowed to bring any document (except those allowed by the professor). Unexcused absences from exams will result in zero grades in the calculation of numerical averages

Macroeconometrics

Professor: Matteo Mogliani, Banque de France; Moaz Elsayed (tutorials)

Contact Information
matteo.mogliani@banque-france.fr
moaz.elsayed@dauphine.eu

Information on the course :
Master Quantitative Economics, First Year, Semester 1
Course load: 24 h of magistral class, 12h of tutorials
ECTS : 6

Overview:
This course will provide the fundamental tools in macroeconometrics. We will cover univariate and multivariate time series, through both theoretical and empirical lectures. The course will start with a review of the basic features of time series stationary stochastic processes, and it will then cover statistical tests, estimation, and forecasting. We will then introduce non-stationarity in time-series and the related testing and modeling approaches. We will finally present the modelling of multivariate time series with VAR models, including the structural analysis that can be run through these models.

Prerequisites
Statistics, econometrics (undergraduate level)

Course Objectives:
The objective of the course is to provide the student with a solid theoretical background and practical knowledge of the methods used to analyse and model time series data. Practical skills will be acquired through training sessions with an econometric software (Matlab).

Mode of Assessment
Mid-term exam + Final exam

Course Schedule

1	Stationary ARMA processes
2	Estimation, validation, and forecasting
3	Non-stationary stochastic processes
4	Cointegration and Error-correction models
5	Vector Autoregressions
6	Structural Vector Autoregressions

Readings

Ghysels, E. and M. Marcellino, (2018), Applied Economic Forecasting using Time Series Methods, Oxford University Press

Hamilton, J.D. (1994). Time Series Analysis, Princeton University Press.

Kilian, L., and H. Lütkepohl (2017), Structural Vector Autoregressive Analysis, Cambridge University Press.

Lütkepohl, H. (2005, 2010), New Introduction to Multiple Time Series Analysis, 1st ed., New York: Springer-Verlag (Paperback).

Access to the educational support

This course is on Moodle : **Yes**

Grading

Students will be assessed based on two written exams. The final grade is made of 40% of the mid-term exam (1h30, in class, around the middle of the semester) and the final exam for the remaining 60% (2h duration).

Class participation: Active class participation – this is what makes classes lively and instructive. Come on time and prepared.

Exam policy: In the exam, students will not be allowed to bring any document (except if allowed by the lecturer). Unexcused absences from exams or failure to submit cases will result in zero grades in the calculation of numerical averages.

Game theory

Professor: David Ettinger, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information :david.ettinger@dauphine.psl.eu

Informations on the course :

Master Quantitative Economics, First Year, Semester 1
Course load:36, 12 sessions of 3 hours per session
ECTS : 6

Overview:

1) Static games in complete information:
- Pure and mixed strategy Nash Equilibrium
- Dominant/dominated strategies and rationalizability

2) Dynamic games in complete information:
- Subgame perfect equilibrium
- Repeated games, folk theorems

3) Incomplete information (in static games):
- Definition of a Bayesian game, Bayesian Nash equilibrium
- Some examples: auctions, e-mail game…

Prerequisites:
Fundamental notions in mathematics and optimization

Course Objectives:
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 for understanding economic phenomena.

Mode of Assessment
The students will be assessed on a written basis. The final grade will be made of a mid-term written exam (for 40%) and a final written exam (60%).

Course Schedule

1	Introduction; definition of a normal form game; pure Nash equilibrium, Expected utility (2 sessions)
2	Dominant/dominated strategies, rationalizability (1 session)
3	Mixed Nash equilibrium (2 sessions)
4	Subgame perfect Nash Equilibrium (2 sessions)
5	Repeated games, folk theorem (2 sessions)
6	Introduction to incomplete information (3 sessions)

Readings
M. Osborne, A. Rubinstein "A course on game theory", MIT Press, 1994 (available on line).
M. Osborne "An introduction to game theory", Oxford University Press, 2003 (elementary version of the previous one).

Access to the educational support
This course is on Moodle : **Yes**

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Grading

The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: Active class participation – this is what makes classes lively and instructive. Come on time and prepared (homework has to be done).

Exam policy: In the exams, students will not be allowed to bring any document.

Data Management and programming

Professor: Fabrice Rossi (Université Paris Dauphine PSL - CEREMADE)

Contact Information : Fabrice.Rossi@dauphine.psl.eu

Information on the course :
Master Quantitative Economics, First Year, Semester 1
Course load: 36h , 12 sessions of 3 hours per session
ECTS : 3

Overview:

This course provides an introduction to programming and to data management, with a data science point of view. The course is based on the R environment. The first part of the course is an introduction to R programming with a data manipulation focus, leveraging in particular the tidyverse and declarative/functional programming. R is used to illustrate the full data science pipeline, from data collection to data visual exploration (including simple statistical models). Concepts from the relational model are presented through examples of complex data described by multiple related entities. The last part of the course is dedicated to an introduction to SQL.

Prerequisites:

Most of the course is self-contained but the students are expected to be familiar with all the mathematical tools associated to an economics curriculum: linear algebra, calculus, continuous optimization, probability and statistics, all at an undergraduate level. A significant part of the examples of data manipulation from the course will make use of this mathematical knowledge. However, the course should be accessible even with only a cursory knowledge of most of the listed concepts.

Course Objectives:

The first objective of the course is to introduce the students to data-driven projects, by presenting the first steps of such projects from data collection to data visualization and exploration. Acknowledging the strong limitations of integrated software that rely solely (or mostly) on graphical user interfaces, the second major objective of the course is to provide all the programming knowledge and tools needed to implement all those data management steps, relying on the R environment. In addition, the links between complex data management in R,

the relational model and SQL are explored.

After having attended the classes, the students will be able to:
- specify a data management chain adapted to a data-driven project;
- build an entity-relationship diagram adapted to describe complex data;
- translate an entity-relationship diagram them into relational schemas;
- identify the potential data value increase at the different steps of a data value chain;
- implement those steps in R: data collection, data cleaning, data storage, data aggregation and other requests, data visualization;
- more generally implement non-obvious data manipulation schemes in R;
- write simple SQL queries.

Mode of Assessment:

The final grade will be made of two types of grading: A continuous assessment grade, made mostly of grades obtained to quizzes and programming tests (approximately 50 % of the grade) and integrating oral participation during the class and regular attendance; A grade obtained on a full data-oriented project from data collection to data visualization (preferably done in groups of 2 students).

Course Schedule

1. Data management introduction and R introduction
2. Rstudio presentation
3. Active document and reproducible research with R markdown
4. R graphics and data manipulation in R
5. R programming (imperative and functional constructs)
6. Tidy data: merging and splitting data tables
7. Relational model
8. Entity association diagrams
9. SQL

Readings
- R for Data Science, H. Wickmann & G. Grolemund, 2017 (https://r4ds.had.co.nz/)
- R Cookbook, J. Long, 2019 (https://rc2e.com/)
- ggplot2: elegant graphics for data analysis, H. Wickham, D. Navarro, & T. L. Pedersen, 2021 (https://ggplot2-book.org/)
- Database System Concepts, A. Silberschatz, H. F. Korth, & S. Sudarshan, 2019 (https://db-book.com/)

Moodle
This course is on Moodle : **Yes**

Semester 2 courses

Courses are either mandatory or elective, namely depending on the chosen Major: Data or Economics. See the overview of the curriculum for a synthetic view.

Public economics

<u>Professor:</u>
Sidartha Gordon (University Paris-Dauphine, LEDa & PSL)

<u>Contact Information:</u> sidartha.gordon@dauphine.psl.eu

<u>Information on the course :</u>

Master Quantitative Economics, First Year, Semester 2
Course load: 30 hours, 10 sessions, 3 hours each
ECTS : 6
Status: Mandatory for Major Economics

<u>Overview:</u>
This is an advanced microeconomics course. It starts with topics related to general equilibrium theory, for example tax incidence. It then moves to the classic models of asymmetric information. It ends with direct taxation and redistribution and an introduction to social choice theory and political economy.

<u>Prerequisites</u>
Microeconomics 1; Game Theory; Undergraduate level Real Analysis.

<u>Course Objectives:</u>
The main objective of this course is to provide a deeper knowledge on general equilibrium theory, for example in the study of tax incidence, to present a comprehensive treatment of the effects of asymmetric information in economic environments and to introduce various advanced topics, such as social choice theory and political economy.

<u>Mode of Assessment</u>
Final Exam (75%, 2h) + in-class participation (25%).

<u>Course Schedule</u>
Part 1: Around General Equilibrium (4 lectures)
1. A model of allocation of resources through the exercise of power
2. Markets with indivisible goods
3. General equilibrium foundation of partial equilibrium
4. Tax incidence in partial and general equilibrium

Part II: Asymmetric information (4 lectures)
5. Competitive markets with asymmetric information
6. Competitive screening
7. The principal-agent model: moral hazard and adverse selection
8. Signaling

Part III: Direct taxation and redistribution (1 lecture)

Part IV: Introduction to social choice theory and political economy (1 lecture)

Readings
Students are encouraged to read the two articles with stars (*) before the semester starts.

Part I
(*) Piccione M. and A. Rubinstein (2007), Equilibrium in the Jungle, *Economic Journal.*
Hayashi, T. (2017), *General Equilibrium Foundation of Partial Equilibrium Analysis*, Palgrave Macmillan, chapter 4.
Salanié B. (2011), The Economics of Taxation, MIT Press, chapter 2.
Atkinson A. B. and J. E. Stiglitz (2015), Lectures on Public Economics, Princeton University Press. Lecture 6.
Mas-Colell, A., M. Whinston, and J. Green (1995), *Microeconomic Theory*, New York, Oxford University Press, Section 15E.

Part II
Mas-Colell, A., M. Whinston, and J. Green (1995), *Microeconomic Theory*, New York, Oxford University Press, Chapters 13 and 14.
Jehle G. A. and P. Reny (2011), Advanced Microeconomic Theory, Third Edition, Prentice Hall, chapter 8.
(*) Einav, L. and A. Finkelstein (2011), Selection in Insurance Markets: Theory and Empirics in Pictures, *Journal of Economic Perspectives* 25-1, 115–138.

Part III
Salanié B. (2011), The Economics of Taxation, second edition, MIT Press, chapter 4.
Atkinson A. B. and J. E. Stiglitz (2015), Lectures on Public Economics, Princeton University Press. Lecture 13.

Part IV
Mas-Colell, A., M. Whinston, and J. Green (1995), *Microeconomic Theory*, New York, Oxford University Press, Chapter 21.
Jehle G. A. and P. Reny (2011), Advanced Microeconomic Theory, Third Edition, Prentice Hall, section 6.2.

Persson T. and G. Tabellini (2000), Political economics, MIT Press, chapters 3 and 6.

Access to the educational support
This course is on Moodle : **Yes**

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Grading

The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: 25%.

Exam policy: Final Exam 75% (2 hours long).

Industrial organization

Professor:

Jérôme Mathis Université Paris-Dauphine – PSL Research University, LEDa

Contact Information : jerome.mathis@dauphine.psl.eu

Information on the course :

Master Quantitative Economics, First Year, Semester 2
Course load: 30 hours, 10 sessions, 3 hours each
ECTS : 6
Status: Mandatory for all

Overview:

The aim of the course is to provide a presentation of modern industrial organization that blends formal models with real-world applications and derives implications for firm strategy and competition policy.

Prerequisites

Microeconomics 1; Game Theory

Course Objectives:

The main objective of this course is to provide a comprehensive exposition of strategies chosen by firms with market power, how such firms adapt to different market environments, and how antitrust authorities can change these environments to induce specific firms behaviors.

Mode of Assessment

Final Exam, Duration : 2h.

Course Schedule

1. Static Models of Oligopoly
2. Quality and Product Differentiation
3. Tacit Collusion and Cartels
4. Asymmetric Information (Static competition, Communication, Limit pricing)
5. Competition and Investment
6. Welfare Standards in Competition Policy
7. Abuse of Dominant Position
8. Consumer Protection

9. Mergers and Acquisitions
10. Market Regulation

Readings

Paul Belleflamme and Martin Peitz (2015): "Industrial Organization: Markets and Strategies", Cambridge University Press.
Jean Tirole (1988): "The Theory of Industrial Organization", MIT Press.

MyCourse

This course is on MyCourse : MyCourse is not used by PSL anymore.

Grading

The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Exam policy: Final Exam 100% of the final grade

Applied microeconometrics

Professors:

Olivia Bertelli (Université Paris Dauphine- PSL, LEDa),
Eric Bonsang (Université Paris Dauphine- PSL, LEDa)

Contact Information

Olivia Bertelli : Olivia.bertelli@dauphine.psl.eu
Eric Bonsang: eric.bonsang@dauphine.psl.eu

Information on the course :

Master Quantitative Economics, First Year, Semester 2
Course load: 30, 10 sessions of 3 hours each
ECTS : 6
Status: Mandatory for Major Economics, Elective for Major Data

Overview:

This course focuses on micro-econometrics techniques based on temporal data (cross-sectional and panel) and qualitative dependent variables. The first part will explore possible sources of OLS bias and discuss techniques and estimators to address those biases (micro-econometrics techniques for temporal data, such as first difference, random effects, fixed effects and difference-in-differences estimators). The instrumental variable estimator, non-linear models (Probit, Logit, Tobit models), as well as selection models (Heckman selection model) will be the focus of the second part of the course.

The main themes are presented under a theoretical perspective, accompanied by empirical applications on Stata.

Prerequisites
Statistics and Probability, statistical inference, hypothesis testing, OLS with multiple variables

Course Objectives:

The objective of the course is to allow students to acquire theoretical and applied knowledge about the range of estimators, their estimation and causal inference applicable to probability models and temporal data.

After having attended the classes, the students will master the main micro-econometrics techniques for probability models and temporal data, and they will be able to critically analyze applied work that employs these types of estimators.

Mode of Assessment

Students will be evaluated in two steps. They will present in pairs a scientific paper among a list provided by the teacher. This will be the same paper to be replicated for the Database and Stata Programming course. The presentation will count for 20% of the final note. The rest of the note will be based on a final written exam scheduled in the exams' week.

Course Schedule

The course can be organized in 7 chapters

1	Sources of bias for OLS
2	Panel models (random effects, fixed effects)
3	Difference-in-differences
4	Introduction to instrumental variables method
5	Linear probability models
6	Models with qualitative dependent variable (Probit, Logit, ordered probit, multinomial logit)
7	Selection models (Tobit, Heckman)

Readings
Selected chapters from:
1. Wooldridge, J. (2002) "Econometric analysis of cross-section and panel data", MIT Press, Cambridge.
2. A. Colin Cameron and Pravin K. Trivedi (2005), "Microeconometrics: Methods and Applications", Cambridge University Press
3. Verbeek, M. (2017). A guide to modern econometrics, 5th Edition, Wiley.

Moodle
This course is on Moodle : **Yes**

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: Active class participation with group work on applied research papers.
Exam policy: In the exam, students will not be allowed to bring any document (except if allowed by the lecturer). Unexcused absences from exams or failure to submit cases will result in zero grades in the calculation of numerical averages. Exams are collected at the end of examination periods.

Microeconometrics: Data applications

Professors:

José Ortega (Paris-Dauphine University, LEDa & PSL Research University), Eric Bonsang (Paris-Dauphine University, LEDa & PSL Research University)

Contact Information

Eric Bonsang (Lecture) : eric.bonsang@dauphine.psl.eu
José Ortega (Tutorials) : jose.ortega@dauphine.psl.eu

Information on the course :
Master 1, Semester 2
Course load: 24 hours, 4 sessions of 1.5 hours and 6 sessions of 3 hours
ECTS : 3
Status: Mandatory for Major Economics

Overview:

The course presents the Stata coding language for applying micro-econometrics techniques. In the first part of the course, the main Stata features are explained by focusing on the estimation of econometric models with qualitative variables and selection models. In the second part of the course, students will learn how to analyse temporal and panel data with Stata and how to estimate temporal models, such as random effects, fixed effects and double differences. Moreover, the course will provide students with the appropriate knowledge for reproducing their econometric analyses in a professional format.

Prerequisites
Statistics and Probability

Course Objectives:

The main objective of this course is to provide students with Stata coding skills for describing and analysing cross-sectional and panel data and for estimating probability and temporal econometric models.

After having attended the classes, the students will be able to describe and analyze phenomena of interest contained in cross-sectional and panel datasets by using Stata. They will be able to

conduct econometric analysis concerning probability and temporal models with graphs and tables formatted in a professional manner.

Mode of Assessment

Coding exercises during the sessions (10%), critical analysis and replication of a research paper's results (90%). The dataset and paper for the replication will be provided by the teachers. The replication paper should include:
1. Introduction (brief summary of the paper and main research questions)
2. Data description (data sources, sample composition)
3. Descriptive statistics (tables and graphs)
4. Econometric model and regression. Present and discuss main hypothesis.
5. Main results.
6. Robustness checks.
7. Conclusions.

Planning / Course Schedule

1	Main commands in Stata
2	Estimation of probability models
3	Estimation of temporal models
4	Graphical analysis of data and econometric results
5	Replication of a research paper's results and critical analysis

Readings
1. Cameron, Adrian Colin, and Pravin K. Trivedi. *Microeconometrics using stata*. Vol. 2. College Station, TX: Stata press, 2010.
2. Gentzkow and Shapiro (2014) "Code and Data for the Social Sciences: A Practitioner's Guide."

Internet resources:
1. Stata video tutorials: https://www.stata.com/links/video-tutorials/
2. UCLA tips: http://www.ats.ucla.edu/stata/

Moodle
This course is on Moodle : **Yes**

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.
Class participation: Active class participation, group work on datasets using Stata, presentation of main results. Come on time and prepared.

Exam policy: The exam will consist of a replication and critical analysis of a research paper's results. It is forbidden to use the authors' coding script.

Topics in Advanced Economic Analysis

Professors:

The list is incomplete at this stage, it will be completed soon to reach 7 topics
Sidartha Gordon (Université Paris Dauphine – PSL, LEDa)
Flore Gubert (Institute for Sustainable Development (IRD) ; Université Paris Dauphine – PSL, LEDa)
Olivia Bertelli (Université Paris Dauphine – PSL, LEDa)
Loic Henry (Université Paris Dauphine – PSL, LEDa)
Anna Creti (Université Paris Dauphine – PSL, LEDa)
Meltem Ozturk (Université Paris Dauphine – PSL, LAMSADE)

Coordinator : Anna Creti (Université Paris Dauphine – PSL, LEDa)

Contact Information
Anna.creti@dauphine.psl.eu

Information on the course :
Semester 2
Course load: 21h , 7 sessions of 3 hours per session
ECTS : 3
Status: Mandatory for all

Overview:

This course presents some recent advances in economic research in close connection with some key challenges facing our contemporary economies, such as: Migration and conflicts; Health policies in light of the Covid crisis; Market design, privacy and platforms; Social responsibility of algorithms, …

Prerequisites
A good knowledge of fundamentals in the various fields of economics

Course Objectives:
The objective of the course is to study the contribution of the very up-to-date advances in economic research to a selected set of contemporary issues at the heart of policy and economic debates. To address these issues, the students will have to make use of their knowledge of the fundamentals of economics (macroeconomics, microeconomics, etc.) they are covering throughout the various courses of the Master degree.

Mode of Assessment
See below (Grading Section)

Course Schedule

Not definitive yet

1	Development and the fight against poverty	Flore Gubert
2	Data and platforms	Sidartha Gordon
3	The economic impacts of climate change	Loic Henry
4	Regulating greenhouse gas emissions	Anna Creti
5	Gender inequality in developing countries	Olivia Bertelli
6	Title TBA	Meltem Ozturk (TBC)
7	Title TBA	TBC

Readings
The specific list of readings will be provided by the researchers intervening for each topic during the first semester.

Access to the educational support
This course is on Moodle : **Yes**

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation:

Exam policy: 100% grading on a final paper, defined as follows.

Students will have to rank three of the seven topics presented to compile a dissertation in groups of two students. The coordinator will make the final topic's assignment based on students' preferences and will try to accommodate their first choice as much as possible. Each instructor will supervise between two to three groups.

Dissertations should be of maximum 10 pages long. These can take two forms:

- A survey of literature on a specific topic (to be discussed with the professor). The survey will cover the theoretical and/or empirical contributions on the subject, critically assessing the main contributions of the literature, and covering also the most recent advances in the area. It should also discuss the potential limitations of the existing literature and the questions that remain to be answered. Finding the relevant articles for the chosen topic is part of the exercise. (Max 5 articles for in depth discussion)
- A proposal for an original empirical research project. The project should be motivated, with a first part explaining the interest of the question with respect to the existing literature (including a pertinent summary of this literature). It should then propose a way

to tackle the question – either theoretically or empirically -, outlining the proposed approach.

The allocation of subjects will be made as follows.
- After having attended all sessions, students will have to fill a form to express their three preferred topics.
- **The choice consists in ranking all topics by order of preference.**
- The coordinator will allocate the subjects to the students. In case of too many students for a given topic, allocation will be made by random drawing.
- The deadline will be specified depending on the planning of the sessions, a few days after the last session, most likely **by the beginning of March.**
- The allocation will be disclosed a few days after.

Once students are informed about the topic assigned, they should contact the advisor in charge to discuss the specific format (literature survey or research project). This will help to detail **the specific format of the dissertation**, and to possibly discuss the set of papers to be covered as well.
The deadline for handing out the dissertation will be common to all topics and specified at the beginning of the sessions.

Business Cycle Analysis

Professor: Lise Patureau
Professor, University Paris Dauphine-PSL, LEDa

Contact Information : lise.patureau@dauphine.psl.eu

Information on the course :
Master Quantitative Economics, First Year, Semester 2
Course load: 24h , 8 sessions of 3 hours per session
ECTS : 3
Status: Elective for Major Economics & Major Data

Overview:
After presenting the stylized facts about the business cycle, the course will study the canonical real business cycle model that focuses on the role of technological shocks as determinant of macroeconomic fluctuations. We will then consider the role of monetary policy. After presenting some empirical evidence on the role of money, we will study the classical monetary model. The third part of the course is dedicated to the basic new Keynesian model with monopolistic competition and nominal price rigidities. Within this framework, we will study the role of technological shocks as well as monetary policy shock and discuss their empirical relevance regarding business cycles features.

Prerequisites
Economics of Growth, Microeconomics at the undergraduate level, optimization tools

Course Objectives:

The course will provide students with sound knowledge and understanding of the basis of modern macroeconomic theory of business cycles. After attending the classes, the students will master the fundamental RBC and New Keynesian models of business cycles. They will get familiar with the modelling of price rigidities to explore the role of monetary policy within New Keynesian models analytically as well as to assess their quantitative predictions in terms of business cycles features.

Mode of Assessment

The final grade will be based on two grades: a mid-term grade (30%) and a final exam grade (70%). The final grade is based on a final written exam (closed-book exam).
The mid-term grade is made on the average grade that each student obtains to 4 quizzes. Quizzes will be given each session, at the beginning of the class, during 10 minutes, except for the first session (no quiz). They aim to check that the content of the previous session has been understood. Quizzes will be randomly corrected (not all students will have a grade each time), but I will manage such that each student will have 4 grades at the end of the semester.

Course Schedule

Session 1	Introduction. Stylized facts about business cycles
Session 2	Part I. The real business cycle model (1)
Session 3	Part I. The real business cycle model (2)
Session 4	Part II. A) Empirical evidence on the role of money
Session 5	Part II. B) The classical Monetary model
Session 6	Part III. A) The basic New Keynesian (NK) model
Session 7	Part III. B) Monetary policy in the NK model
Session 8	Part III. C) Empirical relevance of the NK model

Readings

Gali, Jordi, Monetary Policy, Inflation and the Business Cycle: An Introduction to the New Keynesian Framework, Princeton University Press (2d edition)
King, R., Plosser, C. & Rebelo, S. "Production, Growth and Business Cycles", *Journal of Monetary Economics*, 1988, vol. 21, pp. 195-232.
Gali, J, "Technology, Employment and the Business Cycle: Do Technology Shocks explain aggregate fluctuations?" The *American Economic Review*, 1999, vol. 89, n.1, pp. 249-271

Other references will be provided along the course

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<u>Access to the educational support</u>
This course is on Moodle : **Yes**

<u>Grading</u>
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: A positive bonus by a maximum of + 1 pt will be applied to the mid-term grade to encourage active participation in class. Asking questions is always interesting, for you and the general audience !

Exam policy: mid-term grade (30%) and final exam grade (70%)

In the final written exam, students will not be allowed to bring any document. Unexcused absences from exams or failure to submit the homework assignment will result in zero grades in the calculation of numerical averages. Exams are collected at the end of examination period.

Population Economics

<u>Professor:</u> Julien Bergeot, Université Paris-Dauphine – PSL Research University, LEDa

<u>Contact Information :</u> julien.bergeot@dauphine.psl.eu

<u>Information on the course :</u>
Master 1, Semester 2
Course load: 24 h, 8 sessions of 3 hours per session
ECTS : 3
Status: Elective for Major Economics & Major Data

<u>Overview:</u> Population economics applies an economic perspective to demography or the analysis of human populations. This course will introduce selected fields and research areas that are relevant for the economic analysis of populations, incl. family economics, migration economics, health economics and the economics of ageing. We will discuss theoretical models that help to explain, e.g., the relevance of economic factors for marriage and divorce, how income and education affect the number of children born in a family and investment in these children, or how pension policies affect younger generations. We will consider relevant empirical studies that test hypotheses derived from these models and discuss how economic insights might help to address some of the major challenges of the 21st century, such as population growth in low-income countries, international migration and population ageing in high-income countries.

<u>Prerequisites:</u> None

<u>Course Objectives:</u> After completing the course, students will have an overview of some of the most important theories in population economics and the empirical evidence supporting or contradicting these theories. They will be able to discuss economic aspects of family formation,

fertility, migration, health and ageing. Students will be able to read and critically assess empirical papers on these topics. The course will provide students with the required background for a specialization in health economics, family economics or the economics of ageing for the Master 2 or a Master thesis project in these research areas.

Course Schedule

1	Family Economics: Partnership formation and dissolution, intrahousehold decision-making
2	Family Economics: Fertility
3	Economics of migration: Determinants of migration and selection into migration
4	Economics of migration: Migrant's labour market adjustment
5	Health Economics: Demand for health, early childhood and health in later life
6	Health Economics: Regional variation in healthcare use
7	Economics of ageing: Population ageing and healthcare expenditures
8	Economics of ageing: Pensions and retirement; informal care

Readings
Family Economics:

Almås, I., Attanasio, O., Carneiro, P., 2023. Chapter 3 - Household decisions and intra-household distributions, in: Lundberg, S., Voena, A. (Eds.), Handbook of the Economics of the Family, Handbook of the Economics of the Family, Volume 1. North-Holland, pp. 111–149. https://doi.org/10.1016/bs.hefam.2023.01.008

Chiappori, P.-A., Salanié, B., 2023. Mating markets☆, in: Lundberg, S., Voena, A. (Eds.), Handbook of the Economics of the Family, Handbook of the Economics of the Family, Volume 1. North-Holland, pp. 49–109. https://doi.org/10.1016/bs.hefam.2023.01.002

Doepke, M., Hannusch, A., Kindermann, F., Tertilt, M., 2023. The economics of fertility: a new era☆, in: Lundberg, S., Voena, A. (Eds.), Handbook of the Economics of the Family, Handbook of the Economics of the Family, Volume 1. North-Holland, pp. 151–254. https://doi.org/10.1016/bs.hefam.2023.01.003

Migration Economics:
Bodvarsson, Ö.B., Simpson, N.B., Sparber, C., 2015. Migration Theory*, in: Chiswick, B.R., Miller, P.W. (Eds.), Handbook of the Economics of International Migration, Handbook of the Economics of International Migration. North-Holland, pp. 3–51. https://doi.org/10.1016/B978-0-444-53764-5.00001-3

Duleep, H.O., 2015. The adjustment of immigrants in the labor market, in: Handbook of the Economics of International Migration. Elsevier, pp. 105–182.

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Health Economics:

Grossman, M., 2000. The Human Capital Model, in: Culyer, A.J., Newhouse, J.P. (Eds.), Handbook of Health Economics. Elsevier, pp. 347–408. https://doi.org/10.1016/S1574-0064(00)80166-3

Dalgaard, C.-J., Strulik, H., 2014. OPTIMAL AGING AND DEATH: UNDERSTANDING THE PRESTON CURVE. J. Eur. Econ. Assoc. 12, 672–701. https://doi.org/10.1111/jeea.12071

Skinner, J., 2011. Chapter Two - Causes and Consequences of Regional Variations in Health, in: Pauly, M.V., Mcguire, T.G., Barros, P.P. (Eds.), Handbook of Health Economics, Handbook of Health Economics. Elsevier, pp. 45–93. https://doi.org/10.1016/B978-0-444-53592-4.00002-5

Economics of Ageing:

Zweifel, P., Breyer, F., Kifmann, M., 2009. Future Challenges to Health Care Systems, in: Zweifel, P., Breyer, F., Kifmann, M. (Eds.), Health Economics. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 447–482. https://doi.org/10.1007/978-3-540-68540-1_14
Garrouste, C., Perdrix, E., 2021. Is there a consensus on the health consequences of retirement? A literature review. J. Econ. Surv. n/a. https://doi.org/10.1111/joes.12466
Bell, D.; Lemmon, E. 2022. " The economics of long-term care," in D. E. Bloom, A. Sousa-Poza and U. Sunde (eds), Routledge handbook on the economics of aging. London, Routledge.

Moodle

Pedagogical supports (slides and other materials) will be available through Moodle: **Yes**

Grading

The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Mode of Assessment

Class participation: Encouraged

Exam policy:
- Presentation of a research paper (30% of the final grade)
- Written final exam (70% of the final grade)

Topics in Advanced Industrial Organization

Professor :
Anna Creti, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information
Anna.creti@dauphine.psl.eu

Information on the course:
Master 1, Semester 2
Course load: 21 hours, i.e. 7 sessions of 3 hours each
ECTS: 3
Status: Mandatory for Major Data, Elective for Major Economics

Overview

The course on Advanced Industrial Organization is the follow-up of the basic theories and models developed in the Industrial Organization class. We shall first explore the relationships among firms in the specific context of procurement and regulation. We will the introduce social regulation (economic evaluations that can be used in assessing environmental controls, health and safety). We shall then analyze dynamic aspects of competition that represent critical issues in high technology and information technology industries: innovation and persistence of market dominance, network externalities and two-sided markets. In complement to the Course of Industrial Organization, this course aims at covering most models of imperfect competition among firms to propose an analysis of various pricing strategies, marketing strategies and other strategic manipulations that characterize firms' behavior when they try to gain or maintain market power.

Course objectives

After attending the classes, the students will have acquired a deep understanding of the advanced methods of quantitative industrial organization and game theory, to study the strategic interaction between firms and regulators, and dynamic competition models.

Readings

- Economics of Regulation and Antitrust, Viscusi, Vernon Harrington.
- The Theory of Industrial Organization, Tirole.

Measurement issues with applications to GDP, poverty and inequality

Professors:
Gabrielle Fack, Université Paris-Dauphine – PSL Research University, LEDa
Laura Khoury, Université Paris-Dauphine – PSL Research University, LEDa

Contact Information
Gabrielle Fack gabrielle.fack@dauphine.psl.eu
Laura Khoury : Laura.khoury@dauphine.psl.eu

Information on the course:
Master 1, Semester 2
Course load: 21 hours, i.e. 7 sessions of 3 hours each
ECTS: 3
Status: Elective for Major Economics

Overview:

Is GDP a suitable measure of economic and social progress? What makes a distribution of income more or less equal? How to quantify environmental damages?

This course aims at addressing these questions. In this course, we will analyze the measurement of economic and social outcomes, with a methodological and critical perspective. Policies are often designed based on indexes and quantitative objectives, while defining those indexes and outcomes is not always straightforward. In this course, we will discuss both the theoretical and empirical aspects of how to construct widely used economic indicators, such as GDP, inequality, unemployment, poverty, school quality, etc. How do we translate theoretical concepts into the data? How are the conceptual choices made in terms of what is included or excluded from the computation of an indicator, and how each component is valued? Which data are used and do they allow to observe the entire phenomenon we want to measure?

An introductory session will focus on what to be measured and how to measure it. In particular, it will discuss what the potential biases introduced by data choices (what is the source of the data, the size and representativeness of the sample, etc.). It will be followed by topic sessions on GDP, inequality, employment and unemployment, education, and the measurement of phenomenon that cannot be directly observed

Prerequisites

Statistics (Basic level)
Graduate Econometrics (Microeconometrics)

Course Objectives:

This course will allow students to have a critical eye on how socioeconomic indicators are built. It will provide them with some statistical tools regarding the measurement of economic phenomena and cover more specific measurement issues in a range of economic and social dimensions. This reflection will allow students to better understand some of the controversial questions that are discussed in the public debate, and to themselves build social and economic indicators.

This class will be useful to all students, and in particular those who intend to do a PhD dissertation in economics using empirical data, as well as students who plan to work in institutions that produce economic statistics, studies and policy recommendations.

Course Schedule

1	Introduction to measurement issues in economics
2	Measuring GDP and growth
3	Measuring inequalities
4	Measuring unemployment

5	Measuring poverty
6	Measuring educational outcomes
7	Measuring what cannot be directly observed

Readings
A specific reading list with articles provided at the start of the course

Moodle
Pedagogical supports (slides and other materials) will be available through Moodle: Yes

Assessment
Assessment will be based on a presentation (30%), a written assignment (65%) and participation in class (5%). The presentation will consist of a presentation in class around a topic where measurement issues are central (30%). Regarding the assignment, students will be asked to think about and build some indicators on a specific topic, and to implement the measurement of these indicators on real data.

Unsupervised learning

Professor: TBC

Contact information : TBC

Information on the course:
Semester 2
Course load: 18 hours, 6 sessions, 3 hours per session
ECTS : 3
Status: Mandatory for Major Data

Prerequisites
Basic notions of statistics, probability and optimisation. Also, some notions of coding with R.

Overview:

This course aims at introducing unsupervised learning techniques used for the exploratory analysis of high-dimensional data. It covers foundational methods such as dimensionality reduction and clustering, focusing on both theoretical understanding and practical use-cases in R. The data used for illustration comes from the economics field, and will allow students to learn how to uncover hidden patterns, reduce the dimensionality and interpret latent structures in the data. The course balances statistical rigour with applied insights, in order to build strong analytical foundations for further econometric work.

Course Objectives:

- Understand the theoretical foundations of seminal unsupervised learning methods.
- Acquire hands-on experience on applying dimensionality reduction and clustering techniques in R.
- Develop skills on how to interpret and communicate findings from unsupervised analysis.
- Apply unsupervised learning techniques to relevant economic datasets.

Targeted competencies

- Mastery of clustering methods (hierarchical clustering, k-means).
- Competence in dimensionality reduction (PCA).
- Ability to preprocess and explore high-dimensional economic data.
- Skills in visualizing and interpreting unsupervised learning results.
- Critical thinking about the appropriateness and limitations of unsupervised methods.

Course Schedule

1	Introduction to unsupervised learning and R refresher.
2	Hierarchical clustering.
3	K-means and partitioning methods.
4	Model validation and interpretation.
5	Principal Component Analysis (PCA).
6	Applications and use-cases.

Readings

James et al. (2021). *An Introduction to Statistical Learning*, 2nd edition. Chapters 10-12. [Free PDF online]
R documentation & vignettes for packages: `cluster`, `factoextra`, `factoMineR`, `tidymodels`

Access to the pedagogical materials
The documents associated with this course are available on the Moodle platform: Yes

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class attendance and participation: TBC

Mode of Assessment: TBC

Exam policy : TBC

Programming and web data collection

Instructor:
Bruno Chaves Ferreira (University Paris Dauphine - PSL)

Contact Information
bruno.chavesferreira@dauphine.psl.eu

Information on the course :
Semester 2
Course load: 18 hours, 6 sessions of 3 hours each
ECTS : 3
Mandatory course
Status: Mandatory for Major Data

Prerequisites
Basic notions of programming with Python.

Overview:

This course covers essential Python programming techniques for web data collection in applied economic analysis. Students will learn practical methods to extract structured data from online sources, starting with basics such as HTML/CSS, HTTP requests, XPath, CSS selectors, browser emulation, and public/private APIs (World Bank, INSEE, IMF).

Advanced topics include hidden APIs, overcoming technical obstacles (session management, blocking points), and large-scale data extraction. Students will gain expertise using libraries like requests, BeautifulSoup, and pandas for JSON/XML handling, data cleaning, and pipeline creation.

The course also emphasizes ethics, legal compliance, privacy, and responsible data use. Practical exercises and real-world examples will enable students to develop robust solutions for collecting and analyzing economic data from the web.

Course Objectives:
- Write structured and reusable Python code for data tasks.
- Interact with APIs and process JSON/XML data structures.
- Understand HTML structure and use scraping tools like BeautifulSoup.
- Automate web data collection while following ethical standards.
- Clean, structure, and store collected data for analysis.
- Identify and navigate common technical challenges in web scraping.
- Implement browser emulation techniques for complex data collection scenarios.
- Build reproducible data pipelines to facilitate economic research and analysis.
- Evaluate legal constraints and ethical implications of web data extraction.

Targeted competencies

- Develop robust Python programming skills tailored to data collection and analysis.
- Effectively utilize REST APIs and parse structured web data (JSON/XML).
- Extract data reliably from static web pages using scraping tools such as BeautifulSoup.
- Efficiently clean and transform datasets using pandas and regular expressions (regex).
- Design and document reproducible pipelines for systematic data acquisition and analysis

Course Schedule

Session 1: Introduction to Python and Web Basics
- Python fundamentals for data collection (syntax, structures, environment setup)
- Understanding web technologies (HTML/CSS, basic HTTP requests)
- Introduction to web scraping tools and techniques
- Hands-on practice and exercises

Session 2: Web Scraping Fundamentals
- Parsing HTML content using BeautifulSoup
- CSS Selectors and XPath queries
- Web scraping static pages using HTTP requests (requests library)
- Hands-on practice: scraping simple economic datasets

Session 3: Interacting with APIs
- REST API principles and practices
- Working with public APIs (e.g., World Bank, INSEE, IMF)
- JSON and XML data handling
- Hands-on practice: retrieving and processing API data

Session 4: Advanced Scraping Techniques
- Browser emulation techniques (using Selenium or similar tools)
- Hidden APIs and dynamic content scraping
- Handling blocking points (sessions, headers, cookies, rate-limiting)
- Hands-on practice: scraping complex, dynamic websites

Session 5: Data Cleaning and Pipeline Automation
- Cleaning and structuring data using pandas and regex
- Creating automated, reproducible data pipelines
- Version control and documentation best practices
- Hands-on practice: cleaning and preparing economic datasets

Session 6: Ethical, Legal, and Practical Considerations

Readings

Python and Scaping
https://developers.google.com/edu/python/introduction
https://arxiv.org/abs/2211.04630
https://realpython.com/python-web-scraping-practical-introduction

Ethical, Legal, and Practical Considerations
https://arxiv.org/abs/2410.23432
https://www.cnil.fr/fr/focus-interet-legitime-collecte-par-moissonnage
https://www.captaincontrat.com/protection-des-creations/cgv-cgu-cga/web-scraping-est-ce-legal-me-marcotte
https://fr.wikipedia.org/wiki/Donn%C3%A9es_ouvertes_en_France

Access to the pedagogical materials
The documents associated with this course are available on the Moodle platform: Yes

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class participation: Active class participation – this is what makes classes lively and instructive. Come on time and prepared.

Please bring your laptop. Make sure you have access to wifi (Eduroam).

Mode of Assessment
The participation will be evaluated and will count in the final grading.

The assessment will consist in written exam and an oral presentation of a project made in groups.

Exam policy: In the written exam, students will not be allowed to bring any document (except those specified by the lecturer in advance). Unexcused absences from exams or failure to submit cases will result in zero grades in the calculation of numerical averages. Exams are collected at the end of examination periods.
Students must attend all courses. Any absence must be justified.

Optimization and numerical methods

Instructor: TBC

Contact Information : TBC

Information on the course :
Semester 2
Course load: 24 hours, 8 sessions, 3 hours per session
ECTS: 6

Status: Mandatory for the Major Data

Prerequisites
Basic notions of statistics, probability and mathematical analysis. Basic knowledge of programming with R.

Overview:
This course introduces the basics of optimisation techniques used in machine learning, with a focus on linear models. Students will learn how to formulate learning problems as optimization problems, understand loss functions, and implement optimization algorithms like gradient descent and stochastic gradient descent (SGD). The course emphasizes geometric intuition, convergence analysis, and hands-on coding in R. Topics such as regularization (Ridge, Lasso), model tuning, and evaluation are covered through practical case studies. Students will gain the tools to build, estimate, and critically interpret predictive models using real-world economic and social data.

Course Objectives:
- Formulate supervised or unsupervised learning problems as optimization problems.
- Understand the mathematical foundations of linear models and convex optimization.
- Master gradient-based optimization algorithms and their variants.
- Implement, tune, and evaluate linear models using R.
- Interpret model results in both predictive and economic terms.

Targeted competencies
- Mastery of standard loss functions (e.g., MSE, log-loss).
- Ability to use gradient-based optimization (batch, stochastic, ...).
- Modeling with regularization (Ridge, Lasso).
- Performance evaluation via cross-validation and test error.
- Critical assessment of algorithmic performance and convergence.

Course Schedule

1	Introduction to optimisation and supervised learning
2	Differential calculus and gradient descent
3	Convex optimisation
4	Newton's method and second-order optimisation
5	Regularization : ridge and lasso
6	Stochastic gradient descent

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| 7 | Adaptive gradient descent and model tuning |
| 8 | Case study |

Readings
James et al. (2021). *An Introduction to Statistical Learning*, 2nd ed.
Hastie, Tibshirani & Friedman. *The Elements of Statistical Learning*
Boyd & Vandenberghe. *Convex Optimization*

Access to the pedagogical materials
The documents associated with this course are available on the Moodle platform: Yes

Grading
The numerical grade distribution will dictate the final grade, according to the faculty's recommended grade distribution.

Class attendance and participation: Attendance is mandatory. Beyond two unjustified absences the final mark will be downgraded. Only absences due to medical reasons are considered as justified. Active class participation is strongly encouraged – this is what makes classes lively and instructive. Come on time and prepared.

Mode of Assessment : TBC

Exam policy : TBC