

Courses

Economics, Networks and Business Analytics

Academic Year 2018 – 2019

Advanced Econometrics

Abstract: This module covers some of the most important methodological issues arising in any field of applied economics when the main scope of the analysis is to estimate causal effects. A variety of methods will be illustrated using theory and papers drawn from the recent applied literature. The aim of the module is to bridge the step from a technical econometrics course to doing applied research. The emphasis will be on the application of the methods, rather than the technical details about them. As such, the goal is to provide students with enough knowledge to understand when these techniques are useful and how to implement each method in their empirical research.

The assessment is based on the production of a short empirical project. To do the project students will need to provide a clear research question and a feasible empirical strategy; collect relevant data; implement an appropriate method chosen among one of those explored in the module; draw conclusions and write up the results in a standard academic style in less than 3,000 words.

Topics and Selected Readings:

1. Regression and Causality
 - a. Properties of the Conditional Expectation Function
 - b. Bad controls
 - c. Omitted variable bias
 - d. Measurement errors
 - e. Simultaneous equations
 - f. How to write an empirical project
2. Instrumental variables
 - a. Basics/recap
 - b. IV and causality
 - c. IV with heterogeneous treatment effects – LATE
 - d. Weak instruments
 - e. The bias of 2SLS
 - f. Application II: Miguel et al (2004) on rainfall, economic growth and conflict
 - g. Application III: Nunn (2009) on slave trades and economic performances
3. The Evaluation Problem and Randomised Experiments
 - a. Introduction to the evaluation problem
 - b. Randomised Experiments
 - c. Practical problems when running experiments
 - d. Dulfo et al (2007) on randomization in development
 - e. Application I: Krueger (1999) on class size and educational test scores
 - f. Application II: Blundell et al (2004) on education and earnings in the UK
4. Quasi-Experiments
 - a. Matching
 - b. Propensity Score Matching
 - c. Evaluating the validity of matching estimators
 - d. Application I: Caliendo et al., (2005) on job creation in Germany
 - e. Application II: Jones and Olken (2009) on assassination and institutions
5. Differences-in-Differences
 - a. Basics

- b. Regression Differences-in-Differences
- c. The Synthetic Control Method
- d. Application I: Card & Krueger (1994) on minimum wage and unemployment
- e. Application II: Abadie & Gardeazabal (2003) on the effect of terrorism in the Basque region
- f. Application III: Autor (2003) on unjust dismissal doctrine and employment
- 6. Regression Discontinuity Design
 - a. Sharp RD
 - b. Fuzzy RD
 - c. Running RD Models
 - d. Application I: Lee (2008) on U.S. House elections
 - e. Application II: Angrist & Lavy (1999) on scholastic achievement

Hours: 20

Professors/Lecturers: Vincenzo Bove (University of Warwick)

Specializing course for: Economics, Networks and Business Analytics

Advanced Numerical Analysis

Abstract:

1. General considerations on matrices

Matrices: definitions and properties; norm of matrices

The condition number of a matrix

Sparse matrices and sparse formats (sparsity, structure, functionals)

The role of the PDE discretization (e.g., parameter dependence)

2.a Direct methods for general linear systems

Factorizations: definitions and properties

Factorization algorithms

Cost and numerical stability

2.b Direct methods for sparse linear systems

Factorizations of banded matrices

Ordering strategies to minimize the fill-in of a matrix

Solution of sparse triangular systems

Sparse matrices in Matlab: memorization and handling

Predefined functions for the direct solution of systems

3. Numerical solution of large-scale linear systems

Krylov subspace methods (CG, MINRES, GMRES, IDR family)

Structured problems

Preconditioning

Algebraic multigrid methods (hints)

Numerical experiments with Matlab and the IFISS package

4. Numerical solution of eigenvalue problems

Standard and generalized eigenproblems

Typical numerical methods

Equation of motion in structural dynamics: quadratic eigenproblems

Hours: 20

Professors/Lecturers: Valeria Simoncini (Università di Bologna); Benedetta Morini (Università degli Studi di Firenze)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Advanced Topics in Network Theory: Algorithms and Applications

Abstract: Centrality metrics and spectral properties of graphs.

Community detection.

Bipartite and multilayer networks.

Applications: World Trade Web

Lecture 1: Centrality metrics

Lecture 2: Spectral properties

Lecture 3: Rankings and reputation on graphs

Lecture 4: Community detection in networks I

Lecture 5: Community detection in networks II

Lecture 6: Bipartite networks

Lecture 7: Multilayer networks

Lecture 8: World Trade Web

Lecture 9: Infrastructural network I

Lecture 10: Infrastructural network II

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca); Fabio Saracco (IMT Lucca); Angelo Facchini (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Advanced Topics in Network Theory: Brain Networks

Abstract: TBD

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca); Tommaso Gili (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Advanced Topics in Network Theory: Complex Networks and Python

Abstract: TBD

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Advanced Topics in Network Theory: Dynamical Processes of Networks

Abstract: Mean field and master equations.

Percolation and epidemic models.

Contagion: the case of financial networks.

Applications of network theory.

Lecture 1: Master equations for network models
Lecture 2: Fitness and relevance models
Lecture 3: Epidemic processes in mean fields
Lecture 4: Epidemics on networks
Lecture 5: Scaling and percolation on networks
Lecture 6: Contagion in financial network I
Lecture 7: Contagion in financial network II
Lecture 8: Game theory on networks
Lecture 9: Evolutionary network games
Lecture 10: Networks from time series and visibility graph

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca); Giulio Cimini (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Advanced Topics in Network Theory: Statistical Mechanics of Networks

Abstract: Information theory, Exponential Random Graphs.
Hypothesis testing on networks.
Reconstruction of networks.

Lecture 1: Basics of Information Theory
Lecture 2: Complex Networks Randomization
Lecture 3: Exponential Random Graphs
Lecture 4: maximum Likelihood Estimation
Lecture 5: Hypothesis testing on networks
Lecture 6: Early warnings in economic and financial networks
Lecture 7: Gravity Models of Trade
Lecture 8: Reconstruction algorithms I
Lecture 9: Reconstruction algorithms II
Lecture 10: Reconstruction of interbank networks

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca); Tiziano Squartini (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Analytics in Economics and Management

Abstract: The aim of this course is to teach students how to produce a research paper in economics and management using hands-on empirical tools for different data structures. We will bridge the gap between applications of methods in published papers and practical lessons for producing your own research. After introductions to up-to-date illustrative contributions to literature, students will be asked to perform their own analyses and comment results after applications to microdata provided during the course.

How productive is a firm, an industry or a country? Why? Where is it more profitable to locate an economic activity? Who buys what products? How long can we expect a company to outlive its competitors? What is the relationship between economic welfare and size of a city? How do economic agents interact socially in a geographic space or in a workplace?

The objective is to develop a critical understanding of the iterative research process leading from real economic data to the choice of the best tools available from the analyst kit. Students are expected to be familiar with macroeconomics, microeconomics and econometrics from the first-year sequence.

Final scores will be based 50% on individual presentations of a selected supplemental reading and 50% on an individual homework.

Hours: 20

Professors/Lecturers: Massimo Riccaboni (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Behavioral Economics

Abstract: TBD

Hours: 20

Professors/Lecturers: Ennio Bilancini (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Business Model for Emerging Markets

Abstract:

Teaching contents:

1. The economy of the intangibles
2. Manufacturing and robot
3. Strategy and business model
4. How to model a business
5. How to model a business in a complex scenario
6. What make market emerging? Not only new lands.
7. The Blockchain technology and the future
8. Initial Coins Offering (ICO) compressed between Business plan and White paper
9. Possible value of Blockchain technology for Small and medium Italian sized business
10. A global value chain approach to protect and foster strategic identity

Business case

Students will learn how to evaluate strategies, as well as how to locate sources of potential competitive advantage from a perspective that, for the purpose of this course, encompasses the internal and dynamic fit of a strategy. They will also learn how to identify organizational barriers and corporate behaviors that sustain or challenge the development and execution of strategies, and the competitive advantage of a company.

Hours: 20

Professors/Lecturers: Nicola Lattanzi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Computer Programming and Methodology

Abstract: This course aims at introducing to students principles and methodologies of computer programming. Emphasis is on good programming style, techniques and tools that allow efficient design, development and maintenance of software systems. The course focuses on the design of computer applications drawing attention to modern software engineering principles and programming techniques, like object-oriented design, decomposition, encapsulation, abstraction, and testing. A significative case study is used to allow students to experiment with the principles and techniques considered in this course. Depending on the background of the class, Java, C++, and/or Python are considered in the course.

Hours: 20

Professors/Lecturers: Mirco Tribastone (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Critical Thinking (long seminar without exam)

Abstract: Constructing and evaluating arguments is fundamental in all branches of science, as well as in everyday life. The course provides the basic skills and tools to recognize correct forms of inference and reasoning, detect the unsound or fallacious ones, and assess the strength of various kinds of argument. The toolbox includes elementary deductive logic, patterns of inductive and abductive inference, the basics of statistical and probabilistic reasoning, and the analysis of heuristics and biases in cognitive psychology. We shall discuss real-world examples of correct and incorrect reasoning from both scientific and non-scientific literature (newspapers, social media, and so on). No previous knowledge of logic, philosophy, or advanced mathematics is required.

Hours: 10

Professors/Lecturers: Gustavo Cevolani (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Data Science Lab

Abstract: The aim of this class is to provide students with R language fundamentals and basic syntax. In particular, lessons will cover the following topics:

- Overview of R features
- The basics (vectors, matrices, objects, manipulation, basic statements)
- Reading data from files
- Probability distributions
- Basic statistical models
- Graphical procedures
- R packages overview

Hours: 15

Professors/Lecturers: Valentina Tortolini (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Decision-Making in Economics and Management

Abstract: The main goals of the course are:

- (1) to take economic theories and methodologies out into the world, applying them to interesting questions of individual behavior and societal outcomes;
- (2) to develop a basic understanding of human psychology and social dynamics as they apply to marketing contexts;
- (3) to become familiar with the major theory and research methods for analyzing consumer behavior;
- (4) to develop market analytics insight into consumer actions.

Most of time will be devoted to close reading of research papers, including discussion of the relative merits of particular methodologies. Students will participate actively in class discussion, engage with cutting-edge research, evaluate empirical data, and write an analytical paper. The course aims at enabling students to develop and enhance their own skills and interests as applied microeconomists.

Hours: 10

Professors/Lecturers: Massimo Riccaboni (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Econometrics I

Abstract:

- Review of Asymptotic Theory
- Theory and Algebra of OLS
- Inference, non-spherical Errors and Clustering
- Structural Models, Identification and Causality
- Simultaneous Equation Models, 2SLS and 3SLS
- Introduction to M-Estimation
- Generalized Method of Moments
- Maximum Likelihood Estimation

Hours: 20

Professors/Lecturers: Paolo Zacchia (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Econometrics II

Abstract:

- Microdata and Heterogeneity
- Potential Outcome Framework
- Difference-in-difference and treatment effects
- Linear and Static Panel Data Models
- Linear and Dynamic Panel Data Models
- Non-Linear Models
- Categorical variables and count data
- Multinomial models

Hours: 20

Professors/Lecturers: Armando Rungi (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Finance

Abstract: This course introduces students to the basic concepts used in quantitative finance, which forms the basis for many applications such as derivatives pricing, financial engineering and asset pricing. Anyone interested in these areas will have to acquire a good grasp of the topics in this course. We will cover: the analysis of complete and incomplete markets in discrete and continuous time models; the discussion and extension of the assumptions of the Black-Scholes-Merton equation and the introduction of common numerical techniques that are widely applied in practice (along with practical lab sessions with real data); the introduction of structured finance products, their use in risk management and valuation techniques, most notably for mortgage-backed securities, credit default swaps and collateralized debt obligations.

Students require an adequate knowledge of mathematics, particularly in matrix algebra and analysis along with stochastic processes and stochastic calculus to follow this course. Appropriate readings to refresh your knowledge are given on request.

Outline:

Part I – Pricing Models

- Hedging of securities;

- No-arbitrage pricing;
- Pricing in multi-period models (Binomial Model);
- Pricing in continuous time (Black-Scholes-Merton Model)

Part II - Numerical techniques

- Beyond Black-Scholes-Merton Model;
- Binomial lattices;
- Monte-Carlo simulation;
- Finite differences

Part III – Structured Finance

- Mortgage-backed securities;
- Modeling and pricing corporate default;
- Credit Default Swaps;
- Designing CDOs and exotic CDOs

Prerequisites: Stochastic Processes and Stochastic Calculus

Hours: 20

Professors/Lecturers: Tbd

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Firms, Business Analytics and Managerial Behavior

Abstract:

Teaching contents:

1. Theory of the Firm
2. The system of force in a business organization
3. The balance between efficiency of the production and effectiveness in results
4. Business performance and ways to represent
5. The financial statement
6. How to read and comprehend performances and results
7. Methodology and tools for Balance sheet analysis
8. Prevision versus prediction and business analytics
9. Entrepreneurship and management in complex scenario
10. Neuroscience, decision making process and managerial behavior

Business case

Students will learn how to evaluate strategies, as well as how to locate sources of potential competitive advantage from a perspective that, for the purpose of this course, encompasses the internal and dynamic fit of a strategy. They will also learn how to identify organizational barriers and corporate behaviors that sustain or challenge the development and execution of strategies, and the competitive advantage of a company.

Hours: 20

Professors/Lecturers: Nicola Lattanzi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Forensic Psychology and Psychiatry

Abstract: TBD

Hours: 12

Professors/Lecturers: Pietro Pietrini (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Foundations of Probability and Statistical Inference

Abstract: This course aims at introducing, from an advanced point of view, the fundamental concepts of probability and statistical inference. Some proofs are sketched or omitted in order to have more time for examples, applications and exercises.

In particular, the course deals with the following topics:

- probability space, random variable, expectation, variance, cumulative distribution function, discrete and absolutely continuous distributions, random vector, joint and marginal distributions, joint cumulative distribution function, covariance,
- conditional probability, independent events, independent random variables, conditional probability density function, order statistics,
- multivariate Gaussian distribution,
- probability-generating function, Fourier transform/characteristic function,
- types of convergence and some related important results,
- point estimation, interval estimation, hypothesis testing, linear regression, introduction to Bayesian statistics.

Students may be exonerated up to a maximum of 10 hours according to their background.

Hours: 30

Professors/Lecturers: Irene Crimaldi (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Funding and Management of Research and Intellectual Property (long seminar without exam)

Abstract: The long seminar aims at providing an overview on the management of intellectual property rights (copyright transfer agreements, open access, patents, etc.). Funding opportunities for PhD students, post-docs, and researchers are also presented (scholarships by the Alexander von Humboldt Foundation; initiatives by the Deutscher Akademischer Austausch Dienst; scholarships offered by the Royal Society in UK; bilateral Italy-France exchange programmes; Fulbright scholarships; Marie Curie actions; grants for researchers provided by the European Research Council). For each funding scheme, specific hints on how to write a proposal are given.

Hours: 10

Professors/Lecturers: Marco Paggi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Game Theory

Abstract: The course covers the basics of non-cooperative game theory and information economics. The goal is to equip students with an in-depth understanding of the main concepts and tools of game theory in order to enable them to successfully pursue research in applied areas of economics and related

disciplines, and to provide a solid background for students who are planning to concentrate on economic theory.

The course starts with a detailed description of how to model strategic situations as a game. It proceeds by studying basic solution concepts and their main refinements (dominance and iterative dominance, Nash equilibrium, correlated equilibrium, subgame perfect equilibrium, weak perfect Bayesian equilibrium, sequential equilibrium), strategic interaction under incomplete information (Bayesian games, Bayesian Nash equilibrium), and asymmetric information (adverse selection, signaling, screening, moral hazard, and the principal agent problem). The discussion of all theoretical concepts will be accompanied by representative applications from economics.

The course is mostly self-contained, but students should be familiar with basic concepts from calculus, linear algebra, and probability theory.

Hours: 20

Professors/Lecturers: Kenan Huremovic (IMT Lucca); Ennio Bilancini (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Identification, Analysis and Control of Dynamical Systems

Abstract: The course provides an introduction to dynamical systems, with emphasis on linear systems in state-space form. After introducing the basic concepts of stability, controllability and observability, the course covers the main techniques for the synthesis of stabilizing controllers (state-feedback controllers and linear quadratic regulators) and of state estimators (Luenberger observer and Kalman filter). The course also briefly covers data-driven approaches of parametric identification to obtain models of dynamical systems from a set of data, with emphasis on the analysis of the robustness of the estimated models w.r.t. noise on data and on the numerical implementation of the algorithms.

Prerequisites: Linear algebra and matrix computation, calculus and mathematical analysis.

Hours: 20

Professors/Lecturers: Alberto Bemporad (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

International Economics

Abstract: This course introduces students to the analyses of the most important up-to-date topics in international economics. The objective is to gain an in-depth understanding of the causes and consequences of economic globalization. Emphasis will be given on the internationalization strategies of firms, the organization of production in a global economy, and consequences on labor markets.

Part 1 (F. Serti):

- o Overview of Theories of International Trade
- o International trade and firm heterogeneity: evidence from firm level data
- o Trade and the Labor Market: evidence from local labor markets
- o Trade and the Labor Market: evidence from worker and firm level data
- o Offshoring and tasks

Part 2 (A. Rungi):

- o Gravity Models for International Trade
- o The Role of Multinational Enterprises
- o Organization of Global Value and Supply chains
- o Income inequality and Economic Globalization
- o Trade and Investment Policies

Prerequisites: Microeconomics + Econometrics I + Econometrics II...

Hours: 20

Professors/Lecturers: Massimo Riccaboni (IMT Lucca); Armando Rungi (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Introduction to Cognitive and Social Psychology

Abstract: This course will provide an introduction to general themes in Cognitive and Social Psychology. In the first part of the course, we will review seminal findings that had a major impact on our knowledge of cognitive processes and social interactions, as well as more recent studies that took advantage of neuroimaging, electrophysiology and brain stimulation methods to shed new light on decision-making and social behaviors. During the second part of the course, students will be asked to perform a brief presentation of a research article and to critically discuss positive aspects and limitations of the study. The course will include seminars and lectures by renowned researchers in the field and will educate PhD candidates about the influence of social aspects of the human nature on cognitive and brain functioning (and vice-versa) in an intellectually motivating manner.

Hours: 24

Professors/Lecturers: Pietro Pietrini (IMT Lucca); Emiliano Ricciardi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Introduction to Complex Systems and Networks

Abstract: Complexity, self-similarity, scaling, self-organised criticality.

Definition of graphs, real networks and their properties.

Models of static networks, models of network growth.

Lecture 01 Graph Theory Introduction

Lecture 02 Properties of Complex Networks

Lecture 03 Communities

Lecture 04 Different Kind of Graphs

Lecture 05 Ranking

Lecture 06 Static Models of Graphs

Lecture 07 Dynamical Models of Graphs

Lecture 08 Fitness Models

Lecture 09 World Trade Web

Lecture 10 Financial Networks

Hours: 10

Professors/Lecturers: Guido Caldarelli (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Introduction to Economics

Abstract: (P. Zacchia): Brief introduction to microeconomics designed for students without previous exposure to it.

This module will cover the following topics, focusing on the interplay between formal models and intuitions:

- Individual choice;
- Equilibrium in competitive markets;
- Imperfectly competitive markets;
- Issues of market failures;
- Concepts of information economics.

(F. Serti): This course will provide with a basic introduction of the main notions in Macroeconomics. Its main goal is to give students a big picture of the macroeconomy and the link between output, employment, and inflation in the short term.

After introducing the fundamentals, the course will then introduce basic macroeconomic models such as the Keynesian AD-AS model and the IS-LM model.

The course will also give some introductory notions of the Phillips curve and its relation with the IS-LM model.

Hours: 20

Professors/Lecturers: Paolo Zacchia (IMT Lucca); Francesco Serti (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Machine Learning

Abstract: The course provides an introduction to basic concepts in machine learning. Topics include: learning theory (bias/variance tradeoff; Vapnik-Chervonenkis dimension and Rademacher complexity, cross-validation, feature selection); supervised learning (linear regression, logistic regression, support vector machines); unsupervised learning (clustering, principal and independent component analysis); semisupervised learning (Laplacian support vector machines); online learning (perceptron algorithm); hidden Markov models.

Hours: 20

Professors/Lecturers: Giorgio Stefano Gnecco (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Macroeconomics

Abstract: Search models. Equilibrium search and matching. Two-sided search model. Efficiency wages. Implicit contacts. Insider-outsider models. Traditional Keynesian Theories of Fluctuations. The Lucas Imperfect-Information Model and The Lucas Critique. The New Keynesian Economics. Consumption. Investment.

Hours: 30

Professors/Lecturers: Francesco Turino (Universitat d'Alcant)

Compulsory for: Economics, Networks and Business Analytics

Management of Complex Systems: Approaches to Problem Solving

Abstract: Methods and approach to problem solving. Problem analysis; analysis of complex systems (related to cultural heritage, such as a city of art organization, promotion, etc.). The course will include practical simulations. The course will be linked to a seminar on specific case studies.

Hours: 30

Professors/Lecturers: Andrea Zocchi

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Matrix Algebra

Abstract: This course is aimed to review the basic concepts of linear algebra:

1. Systems of linear equations: solution by Gaussian elimination, PA=LU factorization, Gauss-Jordan method.
2. Vector spaces and subspaces, the four fundamental subspaces, and the fundamental theorem of linear algebra.

3. Determinant and eigenvalues, symmetric matrices, spectral theorem, quadratic forms.
4. Cayley-Hamilton theorem, functions of matrices, and application of linear algebra to dynamical linear systems.
5. Iterative methods for systems of linear equations.
6. Ordinary least squares problem, normal equations, $A=QR$ factorization, condition number, Tikhonov regularization.
7. Singular-value decomposition, Moore-Penrose pseudoinverse.
8. An economic application of linear algebra: the Leontief input-output model.

Hours: 10

Professors/Lecturers: Giorgio Stefano Gnecco (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Microeconomics

Abstract: The course aims at introducing you to graduate-level microeconomic theory. Topics discussed will be:

- Consumer Theory
- Producer Theory
- Choice under uncertainty
- Partial equilibrium and market structure
- General Equilibrium
- Externalities and Public Goods
- Elements of Social Choice Theory (time permitting)

Knowledge of intermediate-level microeconomics is helpful but not necessary. The course will give emphasis to problem solving. For this reason problem sets will be assigned during the course at dates to be communicated in class. Students will then rotate on the board in a following lecture to discuss the problems. There is no required textbook for the course. However, the material presented in class will be taken from Mas-Colell, Whinston, and Green "Microeconomic Theory", which you are encouraged to consult.

Hours: 40

Professors/Lecturers: Andrea Canidio (IMT Lucca); Ennio Bilancini (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Neurobiology of Emotion and Behavior

Abstract: This course will provide an introduction to general themes in Affective and Social Neurosciences, particularly focusing on the neural correlates of emotion and behavior.

Hours: 12

Professors/Lecturers: Pietro Pietrini (IMT Lucca)

Available for: Economics, Networks and Business Analytics

Numerical Methods for the Solution of Partial Differential Equations

Abstract: The course introduces numerical methods for the approximate solution of initial and boundary value problems governed by linear partial differential equations (PDEs) ubiquitous in physics, engineering, and quantitative finance. The fundamentals of the finite difference method and of the finite element method are introduced step-by-step in reference to exemplary model problems related to heat conduction, linear elasticity, and pricing of stock options in finance. Notions on numerical differentiation, numerical integration, interpolation, and time integration schemes are provided. Special attention is given to the implementation of the numerical schemes in Matlab and in the finite element analysis program FEAP for fast intensive computations.

Hours: 20

Professors/Lecturers: Marco Paggi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Numerical Optimization

Abstract: Optimization plays a key role in solving a large variety of decision problems that arise in engineering (design, process operations, embedded systems), data science, machine learning, business analytics, finance, economics, and many others. This course focuses on formulating optimization models and on the most popular numerical methods to solve them.

The topics covered in the course include: modeling (linear programming models, convex optimization models), basic optimization theory (optimality conditions, sensitivity, duality), algorithms for constrained convex optimization (active-set methods for linear and quadratic programming, proximal methods and ADMM, stochastic gradient, interior-point methods), line-search methods for unconstrained nonlinear programming, sequential quadratic programming.

Prerequisites: Linear algebra and matrix computation, calculus and mathematical analysis.

Hours: 20

Professors/Lecturers: Alberto Bemporad (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Optimal Control

Abstract: Discrete-time optimal control: dynamic programming for finite/infinite horizon and deterministic/stochastic optimization problems. LQ and LQG problems, Riccati equations, Kalman filter. Deterministic continuous-time optimal control: the Hamilton-Jacobi-Bellman equation and the Pontryagin's principle. Examples of optimal control problems in economics. An economic application of optimal control: a dynamic limit pricing model of the firm.

Hours: 20

Professors/Lecturers: Giorgio Stefano Gnecco (IMT Lucca)

Compulsory for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Philosophy of Science (long seminar without exam)

Abstract: This is an introduction to the basic concepts and problems in the analysis of scientific reasoning and inquiry. The course will focus on some central patterns of reasoning and argumentation which in science and critically discuss their features and limitations. Topics covered include the nature of theory and evidence, the logic of theory testing, and the debate about the aims of science and the trustworthiness of scientific results. Classical examples and case-studies from the history and practice of scientific inquiry will be employed to illustrate the relevant problems and theoretical positions. No previous knowledge of either logic or philosophy is required.

Hours: 10

Professors/Lecturers: Gustavo Cevolani (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Political Economy

Abstract: The course is a relatively advanced (i.e. at the beginning graduate level) but essentially self-contained introduction to the methods and some major applications of modern political economy.

Topics:

- Institutions and “exogenous” differences in institutions
- At the origin of institutions: From Social Choice to Political Economics
- Median voter models
- Probabilistic voting models
- Agency models of politics: Electoral accountability and career concerns
- Partisan politicians
- Redistributive politics
- Dynamic policy problems with a focus on economic growth.

Prerequisites: The course assumes a good knowledge of macro and microeconomics (especially some growth theory, elementary taxation theory and game theory, including games with asymmetric/incomplete information and the theory of repeated games), of mathematical and statistical methods (especially static and dynamic optimization), and of econometrics (especially familiarity with the issue of causality in econometrics and IV estimation), at the level of the relevant courses offered at IMT.

In addition, students will be asked to read and present some articles along the way as a part of the final exam.

Hours: 20

Professors/Lecturers: Alessandro Belmonte (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Project Management

Abstract: Project management; event management; communication and marketing; practical tools of organization; budgeting. Dealing with multiple stakeholders/ Risk management / Time management / PM tips to run an international research/Management plan concept on heritage sites / When applying for funds how do we measure project success / How we manage the output of the management plan / Flat organisations.

Hours: 35

Professors/Lecturers: Beatrice Manzoni (SDA Bocconi School of Management)

Available for: Economics, Networks and Business Analytics

Science Integrity and Misconduct

Abstract:

1. Introduction

- a. The age of scientific fraud
- b. FFP (Fabrication, Falsification, Plagiarism)
- c. Error, misconduct, fraud

2. Great scientists, successful cheaters

- a. Is scientific fraud a new phenomenon?
- b. Accused: famous scientists were fraudsters?
- c. Present vs past

3. Fraudulent images

- a. Scientific images as data
- b. Introduction to fraudulent image manipulation
- c. Image manipulation detection
- d. Large scale analysis of image manipulation

4. The numbers of scientific disguise
 - a. Lying with numbers
 - b. Detection of numerical manipulations
 - c. Large scale studies

5. Stealing into print
 - a. What is plagiarism
 - b. Plagiarism detection
 - c. Large scale studies

6. The aftermath of fraud
 - a. Damage to Science
 - b. Economic costs
 - c. Effects on our lives
 - d. Personal effects

7. Personal and systemic factors causing misconduct
 - a. Individual factors connected to scientific fraud
 - b. Systemic incentives to fraud
 - c. The social components of scientific fraud

8. What can be done?
 - a. Changing the weight of publications in academic's career: proposals
 - b. Education: do current efforts succeed?
 - c. Editorial Policies
 - Open data policies: current status and perspectives
 - COPE
 - ORCID
 - d. International academic policies
 - Declarations (S. Francisco, Singapore)
 - The position of EU
 - e. Local academic policies
 - Dedicated Institutions: ORI
 - The German way: Ombudsmen and other systems
 - Italy: CNR, Federico II and other guidelines
 - f. Lab policies
 - Italian examples
 - g. Legal policies
 - Administrative and internal (no judiciary intervention)
 - Judiciary (with a review of international trials and sanctions)

9. Beyond scientific fraud: research ethics
 - a. Introducing Ethics in Science
 - b. 3 rules for responsible scientists
 - c. Experimenting with humans and animals
 - d. Unethical behaviours in publishing

Hours: 18

Professors/Lecturers: Enrico Bucci (Resis S.r.l.)

Compulsory for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Scientific Writing, Dissemination and Evaluation (long seminar without exam)

Abstract: In order to ensure their widest possible dissemination, research results need to be presented in academic publications and in talks. The first goal of this course is to introduce students to basic principles of academic writing and on basic techniques to plan and deliver good academic talks. In addition, the course discusses the key principles of peer review, which is what makes science reliable knowledge. In particular, the course focuses on how to write a professional referee report.

Hours: 8

Professors/Lecturers: Luca Aceto (GSSI – L'Aquila)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

Socio-Economic Networks

Abstract: The topic of the course will be the analysis of socio-economic networks. The course will consist of two parts: (1) micro level networks of individuals and firms, (2) macro-level networks of sectors and countries. The first part will focus on social networks and the division of (innovative) labor within and across firm boundaries. The second part on the empirics of macro networks in economics will have a strong focus on international trade, investments and human mobility. Both parts will give you a brief overview on the literature, which predominantly adopted an econometric approach to the analysis of networks.

Hours: 20

Professors/Lecturers: Massimo Riccaboni (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Stochastic Processes and Stochastic Calculus

Abstract: This course aims at introducing some important stochastic processes and Ito stochastic calculus. Some proofs are sketched or omitted in order to have more time for examples, applications and exercises.

In particular, the course deals with the following topics:

- Markov chains (definitions and basic properties, classification of states, invariant measure, stationary distribution, some convergence results and applications, passage problems, random walks, urn models, introduction to the Markov chain Monte Carlo method),
- conditional expectation and conditional variance,
- martingales (definitions and basic properties, Burkholder transform, stopping theorem and some applications, predictable compensator and Doob decomposition, some convergence results, game theory, random walks, urn models),
- Poisson process, Birth-Death processes,
- Wiener process (definitions, some properties, Donsker theorem, Kolmogorov-Smirnov test) and Ito calculus (Ito stochastic integral, Ito processes and stochastic differential, Ito formula, stochastic differential equations, Ornstein-Uhlenbeck process, Geometric Brownian motion, Feynman-Kac representation formula).

Prerequisites: Matrix Algebra + Foundations of Probability and Statistical Inference

Hours: 30

Professors/Lecturers: Irene Crimaldi (IMT Lucca)

Specializing course for: Economics, Networks and Business Analytics

Also available for: Computer Science and System Engineering

Strategies and Business Behavior

Abstract:

Teaching contents:

1. Market and strategy
2. Business and behavioral strategy
3. A new dimension for space and time in organization and strategy
4. Optimization and decision modeling on strategic decision making
5. Skills, competence and a new role of the human being
6. Business behavior as managerial evidence
7. Business plan: the role and function
8. Big data & decision-making process
9. Big data, machine learning for Management science
10. A multidisciplinary approach to business behavior

Business and Behavioral Strategy offers an essential view of the corporate decision-making involved in orchestrating the strategy process - the key ideas, concepts, and tools - and answer to questions like why firms adopt different strategies and structures, why heterogeneity persists. The course will describe the decision-making in competitive markets at the business unit level in which many key strategic choices and actions are formulated and undertaken. The essential “tool-kit” that combines a broad understanding of competitive strategy analysis and the decision-making will be taught in a journey through the frameworks of the analytical and behavioral processes.

The course is divided into three parts.

1. The first focuses on the strategy problem. This part of the course starts by proposing vocabulary and models, which help understand how corporate behaviors influence corporate strategy and sustain (or tackle) competitive advantage depending on the size of the company.

Topic points:

- context and principles of strategic management;
- organizational behavior in entrepreneurial and family firms.

2. The second part focuses on how turning the data and judgment into a decision. It tackles the question of how an executive and business unit can locate opportunities to achieve sustained competitive advantage thanks to the contribution of management science framed within the strategy formulation analytical process.

Topic points:

- optimization and decision modeling;
- problem structuring;
- strategic decision making.

3. The third part focuses on how competency and behavior affect the development and execution of a successful strategy. This part of the course concludes with a discussion of why good analysis in the hands of managers who have good judgment won't naturally yield good decisions. Strategic leaders should be not only competent to read market forces but also competent “practitioner psychologists,” and what developing such competencies entails. This discussion will help surface the biases to which the decision process under review is particularly prone.

Topic points:

- cognitive biases, organization, entrepreneurial and family firm survival;
- the psychology of strategy, rational heuristics and cognitive biases.

Business case

Students will learn how to evaluate strategies, as well as how to locate sources of potential competitive advantage from a perspective that, for the purpose of this course, encompasses the internal and dynamic fit of a strategy. They will also learn how to identify organizational barriers and corporate behaviors that sustain or challenge the development and execution of strategies, and the competitive advantage of a company

Hours: 20

Professors/Lecturers: Nicola Lattanzi (IMT Lucca)

Available for: Computer Science and System Engineering; Economics, Networks and Business Analytics

