PH.D. IN ECONOMICS, STATISTICS, AND SUSTAINABILIY
(38th CYCLE)
PRELIMINARY

MATH SEQUENCE

AN INTRODUCTION TO DYNAMIC OPTIMIZATION (Prof. A. Sacco)

Course Outline: Trigonometric functions. Integration by parts and by substitution. Linear differential equations. Equations with separate variables. Second order differential equations.

Selected references: Further Mathematics for Economic Analysis (second edition), Knut Sydsæter, Peter Hammond, Atle Seierstad, Arne Strom, Pearson.

CFU: 2 (8 ore)

ADVANCED LINEAR ALGEBRA (Prof.ssa S. Corsaro; Prof.ssa Federica Gioia)

Course Outline: Finite precision arithmetic. Linear algebra: Linear equations, Gaussian elimination, stability and pivoting, condition number; Invertible matrix and its inverse; Definite matrix; Orthogonal matrix. Eigenvalues and Eigenvectors. Rank. Computational aspects. Least square approximation. Decomposition: LU and Cholesky factorization, Eigendecomposition, QR factorization. Mathematical programming. Applications with MATLAB and EXCEL.

Selected references: 1. Matrix Computations: Gene H. Golub, Charles F. Van Loan, Editore: Johns Hopkins University Press; 2. Experiments with MATLAB: Cleve Moler https://in.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/book.pdf; 3. Matlab per le applicazioni economiche e finanziarie Cristina Pocci, Giulia Rotundo, Roeland De Kok Editore: Maggioli.

CFU: 6 (24 ore)

AN INTRODUCTION TO DYNAMIC OPTIMIZATION (Prof. G. De Marco)

Course Outline: Antiderivatives and Integrals. Integration by parts and by substitution. Differential equations and the Cauchy Problem. First order ODE: linear equations and separable equations. Higher order ODE: linear equations with constant coefficients, variation of constants. The optimal control problem with finite horizon. The maximum principle. Sufficient conditions: Mangasarian's conditions, Arrow's conditions. Calculus of Variations and the Euler equation.

Selected references: Peter Hammond, Knut Sydsaeter, Atle Seierstad and Arne Strom, *"Further Mathematics for Economic Analysis"*, 2nd Edition, Pearson Education 2008

CFU: 2 (8 ore)

STATISTICS – ECONOMETRICS SEQUENCE

STATISTICS AND R LABORATORY (Prof.ssa A. D'Agostino)

Course Outline: Inference (point estimation, confidence intervals, statistical hypothesis testing). Maximum likelihood estimation methods. Introduction to R. Elementary R programming, Data visualization in R, Manipulate and process data in R.

Selected references: TBA

CFU: 2 (8 ore)

APPLIED MULTIVARIATE STATISTICAL ANALYSIS (Prof.ssa M. Rosciano)

Course Outline: Introduction to multivariate analysis. Data matrix (n,kn,nk,k). Data dimensionality reduction. Factor analysis. Clustering methods. Introduction to SPSS software. Factor analysis and cluster analysis in SPSS.

Selected references: TBA.

CFU: 2 (8 ore)

INTRODUCTION TO ECONOMETRICS (Dott. M. Cerciello)

Course Outline: Fundamentals of spatial econometrics. Spatial data nature. Spatial autocorrelation. Spatial weight matrix. Specification of spatial dependence models. Basic spatial model. Spatial lag model (SAR). Spatial error model (SEM). Spatial Durbin model (SDM). Specification strategies.

Selected references: TBA.

CFU: 2 (8 ore)

APPLIED ECONOMETRICS (Dott. A. Ferraro)

Course Outline: Devising and Estimating Econometric Models for cross-sectional data. OLS. Heteroscedasticity and GLS. Instrumental Variable Estimation: IV, 2SLS, GMM. Economic and Empirical Applications.

Selected references: Greene, W. H. (2018). Econometric Analysis; Stock, J. H. & Watson, M. W. (2014). Introduction to Econometrics; Cameron, A. C. & Trivedi, P. K. (2010). Microeconometrics Using Stata, Revised Edition.

CFU: 2 (8 ore)

ADVANCED MODELING IN STATISTICS (Prof. A. Regoli; Prof. S. Longobardi)

Course Outline: Multiple linear regression: specification and assumptions, statistical inference for regression, dummy-variable regression, analysis of variance, diagnostics. Binary logistic regression for a categorical response variable.

Selected references: TBA

CFU: 2 (8 ore)

COMPOSITE INDICATORS METHODOLOGY (Prof. R. Castellano; Prof. A. Rocca)

Course Outline: The course discusses the definition and the methodology of composite indicators. Selecting variables, multivariate analysis, normalization of data, weighting and aggregation, robustness and sensitivity

Selected references: TBA

CFU: 2 (8 ore)

SAMPLE SURVEYS: PRINCIPLES, METHODS AND APPLICATIONS (prof. G. Punzo)

Course Outline: Background on survey design. Sample design: general concepts. Random and systematic sampling. Stratification and clustering. Multi-stage sampling. Weighting procedures and estimators. A perspective on software for sample designs.

Selected references: TBA

CFU: 2 (8 ore)

A PRIMER FOR SPATIAL ECONOMETRICS (Prof. C. Fiorelli)

Course Outline: Introduction to Spatial Econometrics; Models for spatial panel data; Direct and indirect effects.

Selected references: LeSage, J., & Pace, R. K. (2009). *Introduction to spatial econometrics*. Chapman and Hall/CRC.

CFU: 1 (4 ore)

APPLICATIONS OF SPATIAL ECONOMETRIC TECHNIQUES (Prof. C. Fiorelli)

Course Outline: Analyzing regional economic issues through the key spatial econometric techniques.

Selected references: LeSage, J., & Pace, R. K. (2009). *Introduction to spatial econometrics*. Chapman and Hall/CRC. Pesaran, M. H., Schuermann, T., & Weiner, S. M. (2004). *Modeling regional interdependencies using a global error-correcting macroeconometric model*. *Journal of Business & Economic Statistics*, *22*(2), 129-162.

CFU: 1 (4 ore)

TIME-SERIES ANALYSIS (Prof. De Luca; Prof.ssa G. Rivieccio)

Course Outline: Box-Jenkins methodology. AR, MA, ARMA and ARIMA models. Conditional Heteroskedasticity: univariate GARCH-type models for financial variables. Vectorial Autoregressive models and Granger causality. Unit root test and cointegration. Applications in R.

Selected references: TBA.

CFU: 2 (8 ore)

MACRO SEQUENCE

MACROECONOMIC THEORY I (Prof.ssa Maria Ferrara)

Course Outline: The course provides the analytical tools to set-up and solve Dynamic Stochastic General Equilibrium (DSGE) models analyzing Real Business Cycle theory.

Selected references: Gali' J. (2002) "New Perspectives on Monetary Policy, Inflation, and the Business Cycle"; NBER working paper no. 8767; DOI 10.3386/w8767.

CFU: 1 (4 ore)

MACROECONOMIC APPLICATIONS I (Dott. Gianluigi Cisco)

Course Outline: The course aims to provide the analytical tools for implementing RBC models in DYNARE. Overview: Introduction to the Real Business Cycle (RBC) model, optimality conditions, steady-state, calibration, simulation on DYNARE. Extensions: RBC model and consumption habits; RBC model and capital adjustment costs; RBC model and environmental policies;

Selected references:

- Adjemian, S., Bastani, H., Juillard, M., Mihoubi, F., Perendia, G., Ratto, M., & Villemot, S. (2011). Dynare: Reference manual, version 4.
- Heutel, G. (2012). How should environmental policy respond to business cycles? Optimal policy under persistent productivity shocks. Review of Economic Dynamics, 15(2), 244-264.
- Junior, C. J. C. (2016). Understanding DSGE Models: Theory and Applications. Vernon Press.
- Kydland, F. E., & Prescott, E. C. (1982). Time to build and aggregate fluctuations. Econometrica: Journal of the Econometric Society, 1345-1370;

CFU: 3 (12 ore)

MACROECONOMIC THEORY II (Prof.ssa Maria Ferrara)

Course Outline: The course provides the analytical tools to set-up and solve Dynamic Stochastic General Equilibrium (DSGE) models analyzing real rigidities according to the New Keynesian theory.

Selected references:

- Schmitt-Grohé, S. and Uribe, M. (2005) "Optimal fiscal and monetary policy in a medium-scale macroeconomic model: expanded version"; NBER working paper no. 11417; DOI 10.3386/w11417
- Christiano, L. & M. Eichenbaum & C.L. Evans (2005). "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," Journal of Political Economy, University of Chicago Press, vol. 113(1), pages 1-45, February.

CFU: 1 (4 ore)

MACROECONOMIC APPLICATIONS II (Dott.ssa Monica Varlese)

Course Outline: This course provides the analytical tools to simulate a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model in DYNARE, first solving the steady state of the model, and then writing the DYNARE code to generate the Impulse Response Functions of a selected shock. Course material will be provided during the classes.

Selected references:

- Rubio M., Carrasco-Gallego J.A. (2016) "The new financial regulation in Basel III and monetary policy: A macroprudential approach", Journal of Financial Stability, vol. 16, pages 294-305; DOI 10.1016/j.jfs.2016.07.012.

CFU: 3 (12 hours)

DSGE MODELS AND BAYESIAN ESTIMATIONS IN DYNARE (Prof.. A. Argentiero).

Course Outline: This course is an introduction to the theory of dynamic stochastic general equilibrium models (DSGE) and the techniques of parametrization, focusing in particular on Bayesian estimations. In the first part, starting from a basic structure of a DSGE model, the emphasis is on the main applications of this framework, i.e. fiscal policy and monetary policy both in a closed and open economy. Moreover, we deal with the predictive capacity of these models, through an analysis of the features and limits of the simulation processes. The second part of the course is dedicated to the statistical inference of DSGE models, through a comparison of the Bayesian estimations with calibration and maximum likelihood methodologies. Finally, the students will be enabled to practice the theoretical topics through the software DYNARE. Upon completion of the course, students should be sufficiently familiar with these tools to be able to build and analyze DSGE models. The articles and the texts listed in the course outline include many of the classical papers in the field.

Selected references:

Blanchard, O. J., & Kahn, C. M. (1980). The solution of linear difference models under rational expectations. Econometrica: Journal of the Econometric Society, 1305-1311.

Canova, F. (2011). Methods for applied macroeconomic research. Princeton university press.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end?. Handbook of macroeconomics, 1, 65-148.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. Journal of political Economy, 113(1), 1-45.

Constantinides, G. M. (1990). Habit formation: A resolution of the equity premium puzzle. Journal of political Economy, 98(3), 519-543.

Del Negro, M., & Schorfheide, F. (2004). Priors from general equilibrium models for VARs. International Economic Review, 45(2), 643-673.

Del Negro, M., & Schorfheide, F. (2008). Forming priors for DSGE models (and how it affects the assessment of nominal rigidities). Journal of Monetary Economics, 55(7), 1191-1208.

Del Negro, M., Schorfheide, F., Smets, F., & Wouters, R. (2007). On the fit of new Keynesian models. Journal of Business & Economic Statistics, 25(2), 123-143.

Gali, J. (1999). Technology, employment, and the business cycle: do technology shocks explain aggregate fluctuations?. American economic review, 89(1), 249-271.

Galí, J. (2004). On the role of technology shocks as a source of business cycles: Some new evidence. Journal of the European Economic Association, 2(2-3), 372-380.

Herbst, E. P., & Schorfheide, F. (2015). Bayesian estimation of DSGE models. Princeton University Press.

King, R. G., & Rebelo, S. T. (1999). Resuscitating real business cycles. Handbook of macroeconomics, 1, 927-1007.

Uhlig, H. (1997). A Toolkit for Analyzing Nonlinear Dynamic Stochastic Models EasM ily, B CentER, University of Tilburg and CEPR. mimeo.

CFU: 3 (12 ore)

ADVANCED TOPICS IN MACROECONOMICS AND FINANCE (Prof. F. Busato)

Course Outline: This course covers infinite-horizon optimization via dynamic programming (both deterministic and stochastic) as well as its application to some simple partial- and general-equilibrium models. Will be discussed dynamic models focusing on climate changes, human capital in a dynamic setting. The relation between macroeconomic fundamentals and the cross section of asset returns is studied through the lens of dynamic stochastic general equilibrium (DSGE) models with attention to financial frictions

Selected references: Risk-sensitive real business cycles, Thomas D. Tallarini Jr, Journal of Monetary Economics 45 (2000), Nezafat, Pedram and Slavik, Ctirad, Asset Prices and Business Cycles with Financial Shocks (2014). Available at SSRN: https://ssrn.com/abstract=1571754 or http://dx.doi.org/10.2139/ssrn.1571754, Christiano L.J., Motto R., Rostagno, M. (2014). Risk Shock. American Economic Review. Vol.104, no.1, pp.27-65. Christiano L.J., Motto R., Rostagno, M. (2010); Financial factors in economic fluctuations. ECB No.119, Financial frictions and Fiscal Policy, Ferrara, M., Tirelli, P. (2017). Equitable Fiscal Consolidations. Economic Modelling. Vol.61, pp.207-223, Endogenous market structures and the business cycle. The Economic Journal. Vol. 120, Colciago, A., Etro, F. (2010)., Asset pricing and the propagation of macroeconomics shocks (2018), Financial Business cycle (2014)

CFU: 2 (8 ore)

MICRO SEQUENCE

MICROECONOMIC THEORY (Prof. M. Cerciello)

Course outline: Consumer Theory. Production Theory. General Equilibrium. Imperfect Competition and Market Structure.

Selected references: Varian, H. L. (1992). *Microeonomic Analysis*; Mas-Colell, A., Whinston, M. D., Green, J. R. (1995). Microeconomic Theory

CFU: 2 (8 ore)

GAME THEORY (Prof. B. Chiarini)

Course Outline: Bayesian Equilibrium; Perfect Bayesian Equilibrium; Signaling Games (games with perfect information are taken for granted)

Selected references: M. Osborne, An Introduction to Game Theory, Oxford. B. Chiarini, Un Mondo in Conflitto, Mondadori. Osborne and Rubinsten, A course in game theory, MIT

Selected references: TBA

CFU: 2 (8 ore)

LAW AND ECONOMICS APPROACHES TO LABOR MARKET (Katia Marchesano; Prof. A. Garofalo)

Course Outline: Unemployment, employment and participation. The matching model. Measuring economic effects of labor law: importance and pitfalls. Econometric evaluation of labor law: evaluation problem and parameters of interest. Labor law and its effects on the employment of

disadvantaged workers. A more specific approach: disabled worker's promotion laws and specific institutions for the employability of workers with disabilities.

Selected references: Cahuc, P., Carcillo, S., Zylberberg, A. Labor Economics (Second Edition). The MIT Press Cambridge, Massachusetts- London, England (2014) – Chapter 9 and Chapter 14; Ashenfelter O.C., Card D.(Eds.). Handbook of labor economics (Vol.3A) North-Holland Elsevier (2010) - Chapter 31. Lechael, M., Pfeiffer, F. (Eds.). Econometric evaluation of labour market policies. Centre for European Economic Research (ZEW) Economic Studies Vol.13, Mannheim, Germany (2001). - The effects of employment promotion measures on labour market participation of disabled people: the case of Italy, (M. Agovino, A. Garofalo, K. Marchesano). Qual. Quant., DOI: 10.1007/s11135-016-0455-6, pp. 1-21. (2016)

CFU: 1 (4 ore)

ECONOMICS OF INNOVATION (PROF. L. ALDIERI)

Course Outline: Introduction to Innovation Economics: Definitions and technological change nature. Market structure and innovation: replacement effect and efficiency effect. Technological diffusion processes: Patents and taxonomy of proximities. Technological Innovation and Occupation: displacement effect, compensation effect and polarization effect. Technological change, occupation dynamics and tasks routine.

Selected references: Aldieri L. (2017). Esternalità di conoscenza tra imprese: Aspetti metodologici ed empirici, Giappichelli. - Pepall L., D. J. Richards and G. Norman (2013), Organizzazione industriale, McGraw Hill.

CFU: 2 (8 ore)

INNOVATION AND INTERNATIONALISATION (PROF. C. COZZA)

Course Outline: Theories of technological accumulation. Theories of internationalisation: export, foreign direct investment, global value chains. Empirical analysis on the link between innovation and internationalisation.

Selected references: S. Beugelsdijk et al., "International Economics and Business", Cambridge University Press, 2013; D. Castellani & A. Zanfei, "Multinational firms, innovation and productivity", Edward Elgar, 2006; J. Cantwell, "Innovation and international business", Industry and Innovation, 24(1), 41-60.

CFU: 2 (8 ore)

FIRMS, INNOVATION AND TECHNOLOGY (PROF. I. DI LEO)

Course Outline: Innovation in firms and technological upgrading: drivers, methods and applications. Multilevel modeling, entrepreneurship and growth, individual and country level analyses.

Selected references: Cameron, A.C., Trivedi, P.K. (2009). Microeconometrics Using Stata, Stata press; Selection of scientific papers.

CFU: 2 (8 ore)

FINANCE SEQUENCE

QUANTITATIVE FINANCE (Prof.ssa Z. Marino)

Course Outline: Evaluation models of financial derivatives. Stochastic models. Monte Carlo techniques. Interest rate models. Computational issues.

Selected references: P. Glasserman, Monte Carlo Methods in Financial Engineering, Springer-Verlag New York, 2003; Castellani G, De Felice, M., Moriconi, F., Manuale di finanza, vol. III: Modelli stocastici e contratti derivati., il Mulino, 2006.

CFU: 2 (8 ore)

ADVANCED QUANTITATIVE METHODS IN FINANCE (Prof.ssa F. Perla)

Course Outline: An introduction to the Directive Solvency II. Evaluation of life insurance policies. The Solvency Capital Requirement. The probability distribution forecast. Nested Monte Carlo simulation. Asset–liability management.

Selected references: Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II), Official Journal of the European Union, L335, 17.12.2009. De Felice, M., Moriconi, F., Una nuova finanza d'impresa. Le imprese di assicurazione, Solvency II, le Autorità di vigilanza, Bologna, il Mulino, 2011.

CFU: 2 (8 ore)

TOPICS IN RISK MANAGEMENT (Prof.ssa F. Battaglia)

Course Outline:

Il rischio di mercato del trading book 1°parte: Argomenti trattati: Basilea 3: i rischi di Primo e Secondo Pilastro; i portafogli prudenziali: trading book e banking book; Basilea 4: le principali novità previste per il rischio di mercato dalla “Fundamental Review of the Trading Book”; un’introduzione sui dei modelli interni utilizzati per la stima del requisito patrimoniale a fronte del rischio di mercat. Il rischio di mercato del trading book: Argomenti trattati: Definizione del rischio di mercato e varie sotto-categorie; VaR vs Expected shortfall: principali differenze delle due unità di misura del rischio di mercato; overview dei principali modelli utilizzati per la stima del VaR; i backtesting; l’approccio parametrico e la stima del VaR di una posizione in azioni e in obbligazioni.

Selected references: TBA

CFU: 2 (8 ore)

MACROECONOMIC STABILITY AND FINANCE (Prof. E. Marchetti)

Course Outline: The course offers an introduction to some relevant "non-mainstream" topics in current macroeconomic theory, centered on the general issue of the intrinsic instability of market economies. The programs is organized into three Sections. Section 1: discussion of the current "consensus" approach (NK-DSGE), focusing on the role of self-fulfilling expectations. Section 2: the financial system as a channel for macroeconomic instability. Section 3: the role of asset-price bubbles in deep recessions, great crises and other "extreme" macroeconomic episodes.

Selected references: Part 1: Benhabib J., Wang P., Wen Y. (2015) *Sentiments and aggregate demand fluctuations*, Econometrica, vol. 83. Also: NBER, working paper n.18413, (2012). Farmer R. (1999) *Macroeconomics of self-fulfilling prophecies*, MIT Press. Ch. 10. Part 2: Arnold L. (2002) *Financial market imperfections, labour market imperfections and business cycles*, Scandinavian Journal of Economics, n.104. Part 3: Martin A., Ventura J. (2010) *Economic growth with bubbles*. NBER working paper n.15870; Sec. 1,2.

CFU: 2 (8 ore)

FINANCIAL CRISIS IN A LONG TERM PERSPECTIVE - ENERGY AND ECONOMIC GROWTH (Prof.ssa S. Bartoletto)

Course Outline: the course provides a quantitative history of financial crises: debt crises, credit crises, inflation, currency crises; the bursting of asset price bubbles (equity or real estate) and the role of macroeconomic conditions in the run-up to financial crises.

Selected references: TBA

CFU: 2 (8 ore)

SUSTAINABILITY SEQUENCE

EXPERIMENTAL ECONOMICS (Prof. R. Vecchio)

Course Outline: The course is intended to guide PhD students in the comprehension of experimental economics mechanisms and their underlying rationale. In particular, the course will focus on two of the most frequently applied incentive-compatible value elicitation mechanisms: non-hypothetical experimental auctions and multiple price-list experiments.

Selected references: Vecchio R., Annunziata A. (2018) "Experimental Economics to Evaluate Consumer Experience," in (Ares and Varela) *Methods in Consumer Research, New Approaches to Classic Methods Volume 1*. Elsevier.

CFU: 1 (4 ore)

INTERNATIONALIZATION AND FOOD COMPANIES (Prof. F. Boccia)

Course Outline: Globalization and internationalization: theory. Internationalization and big companies: business and production. Strategy and internationalization: reasons, barriers and development. Exports, contracts, Foreign Direct Investment. Joint-venture. International

marketing. Corporate Social Responsibility and sustainability. Multinational corporations: impact and features.

Selected references: TBA.

CFU: 2 (8 ore)

ECONOMICS OF FOOD SYSTEM AND SUSTAINABILITY (Prof.ssa A. Annunziata)

Course Outline: The modern agro-food System in the sustainability context; The global food paradoxes; New trends in food demand; Effects of asymmetric information on consumer food choices; Determinants of sustainable food consumption; Food labeling and certification schemes for sustainability; Food sustainability index.

Selected references: TBA.

CFU: 3 (12 ore)

CLIMATE FINANCE FOR ENERGY SUSTAINABILITY (Prof. G. Scandurra)

Course Outline: The course aims to introduce students to methods for assessing the effectiveness of climate finance to promote the green growth and energy sustainability in developed, developing and Last Developing countries. The course will focus on the economic instruments, identified at international level, to be put in place and implemented in order to encourage: a) investments in Renewable sources; b) green growth; c) energy efficiency. Moreover, will be introduced the statistical indicators to assess the impacts of planned interventions and the most common statistical methodologies for analyzing the impacts these interventions.

Selected references: Scandurra, G., Romano, A., Carfora, A., Ronghi, M., 2017. Climate Finance as an Instrument to Promote the Green Growth in Developing Countries. SpringerVerlag, Berlin. ISBN 978-3-319-60710-8, DOI: 10.1007/978-3-319-60711-5 Scientific papers will be suggested.

CFU: 2 (8 ore)

SPECIAL TOPICS

INTRODUCTION TO TREATMENT EFFECTS AND POLICY EVALUATION WITH APPLICATIONS TO INNOVATION POLICIES (Dott. P. Piselli).

Course Outline: This is a short course of Causal inference with observational data. Problems with inferring causal relationships from non-experimental data are briefly reviewed and some classes of methods designed to allow estimation of and inference about causal parameters are described: panel regression, difference in difference, matching, instrumental variables and regression discontinuity. Practical examples are offered, and discussed basically with application to the effects of policies to promote R&D and innovation activities of firms.

Selected references: TBA

CFU: 1 (4 ore)

TOPICS IN WATER ECONOMICS (Prof.ssa E. Marzano);

Course Outline: Economic Aspects of Ground Water Resources; Groundwater Management When Water Quality Is Endogenous; Groundwater ecosystem services

Selected references:

Gisser, M., Mercado, A., 1973, Economic Aspects of Ground Water Resources and Replacement Flows in Semiarid Agricultural Areas, *American Journal of Agricultural Economics* , Aug., 1973, Vol. 55, No. 3 (Aug., 1973), pp. 461-466

Koundouri P., 2004 Potential for groundwater management: Gisser-Sanchez effect reconsidered, *Water Resources Research*, VOL. 40, W06S16, doi:10.1029/2003WR002164, 2004

Griebler, C. Avramov, M., 2015, Groundwater ecosystem services: a review, *Freshwater Science*. 2015. 34(1):355–367. © 2015 by The Society for Freshwater Science

Roseta-Palama C., 2002, Groundwater Management When Water Quality Is Endogenous, *Journal of Environmental Economics and Management* 44, 93–105 (2002)

CFU: 2 (8 ore)

LAW AND ECONOMICS APPROACHES TO ENVIRONMENTAL ISSUES (Prof.ssa Katia Marchesano)

Course Outline: Economic Analysis of environmental Law: An Introduction. Measuring economic effects of environmental law: evaluation problem and parameters of interest.

Selected references: Faure, M., & Partain, R. (2019). Environmental Law and Economics: Theory and Practice. Cambridge: Cambridge University Press. doi:10.1017/9781108554916; - Agovino, M.; Casaccia, M., Crociata, A. (2017) Effectiveness and efficiency of European Regional Development Fund on separate waste collection: evidence from Italian regions by a stochastic frontier approach, Economia Politica.

CFU: 1 (4 ore)

ENERGY EFFICIENCY (Prof.ssa Maria Chiara D'Errico)

Course Outline: Stochastic frontier analysis. Data envelopment analysis. Efficiency change over time. Multi-stage use of non-parametric models.

Selected references: Cooper W. W., Seiford L. M., Tone K., Data Envelopment Analysis, Springer, New York, 2007; Aparicio J., Lovell C. K., Pastor, J. T. . Advances in efficiency and productivity II. Springer - Operations Research & Management Science, New York, 2020.

CFU: 2 (8 ore)

ENVIRONMENTAL ECONOMETRICS (Prof. M. Agovino)

Course Outline: Environmental policy making intrinsically rests on accurate estimates of the impact of the environment (climate, pollution etc.) on economic outcomes (health, production etc.) and the impact of economic behaviour on the environment. The nature of data and contexts involved, however, make the approaches and challenges fairly unique to the field. This course will

cover some of the common problems and methods used in many environmental applications of econometrics. Sustainable development inevitably will need empirical studies to help evaluate possible relevant policies. This course will provide students with the skill set to do so.

Selected references: Angrist, J. D., & Pischke, J.-S. (2009). Mostly harmless econometrics: An empiricist's companion. Princeton: Princeton University Press.

Haab, T. and McConnell, K. (2002). Valuing Environmental and Natural Resources, Edward Elgar Publishing.

Dunning, T (2012). "Natural Experiments in the Social Sciences: A Design Based Appraoch", Cambridge University Press.

Coles, S. (2001). "An Introduction to Statistical Modelling of Extreme Values", Springer Verlag.

CFU: 2 (8 ore)