Econometrics

Target Audience: PhD Students 41st cycle

Duration: **24 Hours**

- **12** hours **Professor Toma Pierluigi, PhD -** toma@lum.it
- **12** hours **Colamartino Chiara, PhD -** colamartino@lum.it

Course Format

This course aims to provide doctoral students with both the theoretical foundations and practical skills necessary to design, implement, and interpret econometric analyses relevant to research in economics, management, and social sciences.

Through a combination of lectures, hands-on exercises, and research discussions, students will develop an understanding of econometric methods as tools for empirical inquiry and theoretical validation.

By the end of the course, students should be able to:

- understand the role of econometric methods in generating and testing theoretical contributions in applied research;
- identify appropriate econometric techniques for different types of data and research questions;
- manage datasets, perform regressions, and interpret statistical results using R;
- design empirical research strategies coherent with their theoretical frameworks;
- critically evaluate methodological choices and econometric evidence in academic literature;
- integrate econometric techniques into their own research proposals and present them effectively.

Six four-hour sessions of teaching classes are provided, plus four hours of interactive teaching dedicated to e-tivities supporting the students' final work development.

Interactive teaching activities will be scheduled with the students throughout the semester.

Session 1: November, 21 (Colamartino, 4 hours)

Topics	• Introduction to Econometrics: Purpose, scope, and applications. • Ordinary Least Squares (OLS): Theory, assumptions, and interpretation. • OLS Applications in R: Introduction to R environment, loading and exploring datasets, running simple regressions. • Practical Exercises: Dataset preparation, variable selection, and regression diagnostics
Paper Analysis	Discussion of key methodological papers on OLS and regression analysis.
Discussion	Initial discussion with students about their projects and methodological needs; Deep dive into student research ideas and collaborative methodological solutions.

Session 2: November, 28 (Toma, 4 hours)

Topics	• Advanced OLS Applications: Detecting and correcting heteroskedasticity, multicollin earity, and autocorrelation. • Data Management in R and Excel: Dataset cleaning, variable transformation, and handling missing data. • Hands-on Exercises: Practical implementation of data cleaning and regression robustness checks.
Paper Analysis	Review of selected papers addressing real-world econometric challenges.
Discussion	Identifying potential econometric approaches for student projects.

Session 3: December, 4 (Toma, 4 hours) & Session 4: December, 4 (Colamartino, 4 hours)

Topics	• Panel Data Analysis • Fixed and Random Effects models. • Model selection and interpretation. • Applications using R (plm package). • Moderation and Mediation Analysis: Concepts, interpretation, and practical implementation. • Hands-on Session: Building models with interaction effects and indirect effects in R.
Paper Analysis	Examination of recent papers applying panel data and mediation/moderation models.
Discussion	Student-led reflection on potential applications of panel and mediation models to their re search frameworks.

Session 5: December, 11 (Toma, 4 hours) & Session 6: December, 11 (Colamartino, 4 hours)

Topics	• Binary Response Models: Introduction to Probit and Logit models. • Hands-on Session: Implementing and interpreting Probit and Logit regressions in R. • Advanced Applications: Model comparison, marginal effects, and goodness-of-fit. • DEA (Data Envelopment Analysis): Conceptual foundations and basic implementation. • Optimization Techniques: Introduction to efficiency analysis and optimization tools in econometrics.
Paper Analysis	Review of key methodological contributions on non-linear models and efficiency analysis.
Discussion	Integration of advanced econometric and optimization techniques with doctoral research projects.

Program Modifications

This syllabus is flexible and will adapt to the evolving needs of the students, focusing on providing practical, research-relevant skills. The schedule outlined in this syllabus may be subject to changes to enhance the course delivery and address the methodological needs of PhD students.

Assessment

The final grade for the course will be determined as follows:

- **Active Participation in Class (50%)**: Students are expected to engage actively in discussions, hands-on exercises, and methodological analyses during the sessions. Integrated assignments may be proposed throughout the course to reinforce learning outcomes; these in-class or take-home tasks will contribute to the active participation grade.
- **Final Assignment (50%)**: Each student must submit a single project that integrates theoretical understanding and practical application of one or more techniques covered during the course. The assignment should contextualise the chosen methods within the student's research project or proposed research idea, providing a clear methodological rationale and a brief introduction to the research framework.