

SYLLABUS

EC512E

Econometrics

ACADEMIC AREA :	FINANCE AND GEOPOLITICS
PROGRAMME :	MASTER DAIS / PGTC LEVEL 5
PERIOD :	FALL
COORDINATOR :	Mr. Roman MATKOVSKYY
INSTRUCTOR(S) :	Mr. Alassane DIALLO
CONTACT HOURS :	24.0 hours
STUDY TIME :	null hours (Class preparation, homework and assessments)
CREDITS :	4.0 ECTS
AOL :	NO

PRE-REQUISITE MODULES :

Introductory courses to finance and statistics will be of great assistance.

MODULE DESCRIPTION :

Graduates in IF require solid empirical grounding to investigate relationships, focusing on techniques to help understand patterns in observations, which correlations speak to a causal relationship and which do not.

This course aims to provide students with an intensive training in econometrics. This course will cover the main empirical topics in finance. The goal is to get students to think both about the empirical challenges associated with finance, and possible models and mechanisms underlying the discussed phenomena. Students will study the core concepts related to estimation of model parameters, prediction of outcomes, and statistical inference. The whole course will be based on R

CONTRIBUTION TO PROGRAMME LEARNING OBJECTIVES :

- Connect physical and digital spaces through advanced technological, AI and Data literacy to steer activities and processes
#ConnectSpaces

This module contributes to #ConnectSpaces by developing students' ability to use R, financial data and advanced quantitative methods to investigate financial relationships and support evidence-based decision-making. Students learn to transform, analyse and model financial data using econometrical tools, enabling them to translate complex digital information into meaningful financial insights.

Through hands-on modelling and empirical analysis, students develop the technological and data literacy required to select appropriate analytical methods, implement models, evaluate their outputs and generate forecasts under uncertainty. The module therefore strengthens their capacity to use digital and data-driven tools to steer financial analysis, risk assessment and decision-making processes in contemporary financial organisations.

MODULE INTENDED LEARNING OUTCOMES (ILOs) :

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

ILO 1. Diagnose empirical finance problems by formulating appropriate research questions and identifying suitable econometric approaches to investigate financial relationships and market behaviour.

ILO 2. Evaluate and select relevant financial and empirical information from multiple sources to support evidence-based modelling, forecasting, and financial analysis.

ILO 3. Apply econometric, time-series, volatility, and machine learning techniques using R to estimate models, analyse financial data, and generate forecasts under conditions of uncertainty.

ILO 4. Evaluate and justify econometric findings by interpreting model outputs, assessing model limitations, and formulating evidence-based recommendations for financial decision-making, risk management, and organisational performance.

TOPICS COVERED :

- Introduction to a programming language (R). Data manipulation, loops, if statements, functions, graphs etc.
- Introduction to econometrics. Exploratory data analysis. Distributions. Univariate and multivariate tests.
- Regressions and their application. Model selection. ANOVA. Troubleshooting.
- Some advanced topics on regression. Binary regressions. Panels. Application.
- time series models; forecasting; volatility.
- Introduction to machine learning in finance: Similarity, classification and clustering.

RESEARCH-LED TEACHING :

The course integrates empirical research conducted in the finance industry. Real-world financial data, case studies, and examples are used to illustrate the application of econometric techniques and their implications for financial decision-making. By incorporating practical examples and industry-relevant research, the course bridges the gap between theoretical concepts and their real-world implementation. Moreover, the course takes into account the evolving nature of financial markets and emerging research trends. This includes addressing the analysis of cryptocurrencies, which is a rapidly growing area of interest in financial econometrics. The course incorporates relevant research on crypto finance, statistical properties of crypto returns, and the relationship between cryptocurrencies and traditional financial assets.

CSR AND SUSTAINABLE DEVELOPMENT GOALS :

gender equality topics are modeled and discussed

CSR NB HOURS :

2

SUSTAINABLE DEVELOPMENT GOALS COVERED :

- 05 - Gender equality

TEACHING METHODS :

In this course we focus on econometrical tools and their application in R.

Each session is composed of a short theoretical introduction with applied examples, followed by exercises, suggested solutions and discussion. Solutions and examples of R codes are provided. Ideally, having a personal laptop during the sessions would be beneficial.

METHODS OF ASSESSMENT :

Continuous/Final	Group/Individual	Assessment	Weight	Duration	ILOs assessed
Continuous	Individual	Quiz	15%	30 Minutes	1, 2, 4
Continuous	Individual	Written assessment at home	85%	3 Heures	all ILOs

Assessment 1 details:

The continuous assessment I is a Moodle quiz, related to concepts taught in the first half of the course.

Assessment 2 details:

The Final assessment is an individual project, that relates to individual research interests or to the proposed sub-projects from the module

ACADEMIC INTEGRITY :

Academic integrity at Rennes SB is about sharing a set of values and practices promoting intellectual honesty, trust, fairness, respect and responsibility in all aspects of learning, studying and researching. Upholding academic integrity is key to maintaining the reputation of the student and the ultimate value of Rennes SB Degrees. Students are expected to demonstrate these values when submitting assessed work.

Academic misconduct is defined as gaining or attempting to gain an unfair academic advantage for yourself or for others during formal assessments. The following are examples of academic misconduct:

- Cheating
- Plagiarism
- Falsification
- Gaining an unfair advantage
- Assisting others in committing academic misconduct, such as by using generative AI
- Falsification of records or official documents
- Unauthorised access to restricted information or data
- Unauthorised or unethical use of generative AI

Academic misconduct is a serious offense and can result in consequences such as module failure, research project failure, or even exclusion from Rennes SB. To prevent unintentional academic misconduct, it is essential to read and comply with the Rennes SB Academic Integrity Policy for Assessments (available on RISE). Regarding use of AI in learning and assessment please consult your professor for specific instructions pertaining to this module.

BIBLIOGRAPHY :

Econometrics and modelling:

William H. Greene (2012) Econometric Analysis, 7th edn . Pearson Education, 1228 p. Ebook [<https://research-ebsco-com.rennes-sb.idm.oclc.org/c/vnqiug/search/details/vrjhu4uq3j?request-context=plink&db=nlebk>]

Rupert, D., Matteson D.S. (2015) Statistics and Data Analysis for Financial Engineering with R examples. Springer. Ebook [<https://www-vlebooks-com.rennes-sb.idm.oclc.org/Product/Index/1922640?page=0&startBookmarkId=-1>]

Additional Reading

R <https://www.r-project.org/>:

Rtips. Revival 2014! By Paul E. Johnson - <https://pj.freefaculty.org/R/Rtips.pdf>

Statistics With R, by Vincent Zoonekynd - http://zoonek2.free.fr/UNIX/48_R/all.html

R Programming - https://en.wikibooks.org/wiki/R_Programming

Chapman C.N., Feit, E. Mc-D. (2019) R for Marketing Research and Analytics 2nd edn. Springer.

Mathematics and statistics:

Bradley, T., Patton, P. (1998). Essential Mathematics for Economics and Business, Wiley and Sons (to recall mathematics)

Diez, D., Çetinkaya-Rundel, M. and Barr, C.D. (2019) OpenIntro Statistics, Fourth Edition.

Alpaydin, E. (2014) Introduction to Machine Learning, MIT press, 3rd edn.

Research papers:

Matkovskyy, R., Jalan, A. and Dowling, M. (2020). 'Effects of economic policy uncertainty shocks on the interdependence between cryptocurrency and financial markets' Quarterly Review of Economics and Finance

Yarovaya, L., Matkovskyy, R. & Jalan, A. (2020). The Effects of a 'Black Swan' Event (COVID-19) on Herding Behavior in Cryptocurrency Markets: Evidence from Cryptocurrency USD, EUR, JPY and KRW Markets. Available at SSRN: <https://ssrn.com/abstract=3586511> or <http://dx.doi.org/10.2139/ssrn.3586511>.

Yarovaya, L., Matkovskyy, R. & Jalan, A. (2020) The Effects of a 'Black Swan' Event (COVID-19) on Herding Behavior in Cryptocurrency Markets, Journal of International Financial Markets, Institutions and Money, 101321.

Matkovskyy, R., Jalan, A. (2021) Can Bitcoin be an inflation hedge? Evidence from a quantile-on-quantile model. Economic review 7, 1024-1041

Matkovskyy, R., Bouraoui, T., Hammami, H. (2016) Analysing the financial strength of Tunisia: An approach to estimate an index of financial safety, Research in International Business and Finance 38, 485-493

MODULE PLAN SESSIONS :

Plan Session 01 :

Introduction to the course.
 Introduction to a programming language (R).
 Types of variables and objects in R.
 Import/export data. APIs
 If statements, else statements.
 Loops.
 Functions.
 Graphs.

reading:
 Moodle Session 1 slides and R codes

http://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

R for Marketing Research and Analytics, by Chapman & Feitm Chapter 2

Plan Session 02 :

Basic stats.
 Probability and the Statistical Foundations of Econometrics.
 Estimation of location and variability.
 Hypotheses, P value, confidence intervals
 Distributions.
 Testing Normality
 Correlation.
 Data transformation and variance stabilization.

reading
 Moodle Session 2 slides and R codes

R: Respective chapters from "Statistics With R" by Vincent Zoonekynd OR R Programming R for Marketing Research and Analytics, by Chapman & Feitm Chapter 3

Review Greene (2012): Chapters 1- 2 and respective chapters from Rupert & Matteson (2015)

OpenIntro Statistics, by Diez et al (2019) Chapters 3,5

Relative chapters from Bradley, Patton (1998) to recall mathematical

Plan Session 03 :

Basic stats 2

- Distributions
- Normality
- Mean, variance, covariance, correlation
- Tail Dependence & Quantile Correlations
- Conditional Tail Correlation
- Univariate extremogram
- Cross Extremogram
- Rolling (timevarying) correlation
- Statistical significance of correlation

Moodle Session 3 slides and R codes

Review Greene (2012):

Distributions : Appendix B.2.1 (Probability distributions), B.2.2 (CDF); specific families in B.4:

B.4.1 Normal, B.4.2 Chi-squared, t, and F; B.4.3 Large-df limits; B.4.4 Lognormal; B.4.5 Gamma & Exponential; B.4.6 Beta; B.4.7 Logistic; B.4.8 Wishart; B.4.9 Discrete RVs. B.4.1 The Normal Distribution (incl. standard normal, , and linear transforms)

Mean, variance, covariance, correlation : B.3 (Expectations: mean & variance; Defs. B.1–B.2) and B.7.3 (Covariance and correlation; within Joint distributions B.7 and Expectations in a joint distribution B.7.2)

Definitions in C.3 (covariance/correlation, sample formulas) and general testing framework in C.7 Hypothesis testing (use this with the t distribution from B.4.2 for tests of zero correlation under normality).

Plan Session 04 :

Simple regression.

Multiple regression.

Standard Errors, t-Values, and p-Values. Analysis of Variance, Sums of Squares, and R^2 .

Model selection (AIC/BIC). ANOVA.

Collinearity and Variance Inflation.

Troubleshooting.

Reading

Moodle Session 4 slides and R codes

Review Greene (2012) Chapters 2,3,4,5

Respective chapters from Rupert & Matteson (2015)

R: Respective chapters from “Statistics With R” by Vincent Zoonekynd OR R Programming OpenIntro Statistics, by Diez et al (2019) Chapters 8

Relative chapters from Bradley, Patton (1998) to recall mathematical

Plan Session 05 :

Some advanced topics.

Nonlinear Regression.

Transformation.

Binary Regression.

Reading

Moodle Session 5 slides and R codes

Review the respective chapters of Greene (2012), Chapters 7, 14

Respective chapters from Rupert & Matteson (2015)

Relative chapters from other reading

Plan Session 06 :

Time series.
Stationarity.
Serial correlation/ autocorrelation
AR(), MA(), ARMA()
Volatility models (GARCH, EGARCH, TGARCH)

Moodle Session 6 slides and R codes
Respective chapters from Rupert & Matteson (2015)
Relative chapters from other reading

Plan Session 07 :

Dimension Reduction. PCA. Factor models

Moodle Session 7 slides and R codes
Relative chapters from other reading
Matkovskyy, R, Bouraoui, T. Hammami, H. (2016)

Review Alpaydin (2014), chapters 1, 7(k mean), 8.2.3 (kN), 8.6 (distance-based)

Plan Session 08 :

Presentations

