COURSE UNIT (MODULE) DESCRIPTION

Subject	Science Category	Faculty
Research Methods	Economics S 004	Faculty of Economics and Business Administration

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	200	36	164

Coordinator:
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Annotation

This course is tailored for PhD students in Economics, focusing on essential research methods and tools necessary for conducting rigorous academic research. The course is structured into three parts: (1) Introduction to Data Science with R, (2) Introduction to MATLAB, and (3) Planning and Writing a Research Paper. Through this course, students will gain expertise in developing research papers, analyzing data, and applying computational techniques essential in modern economic research. The aim of this part is to provide an introduction to planning and writing a paper to PhD students who are about to start their research career.

Course Outline

Part A: Introduction to Data Science
1. Why R?
2. RStudio integration with Git/Github: version control
3. Basics of R
    (a) Functions
    (b) Parallelization
    (c) Understanding object-oriented programming and use of source
4. Data wrangling
    (a) Workflow basics
    (b) Dataframe and tibbles
    (c) Pipes
    (d) Data transformation
    (e) Data tidying using tidyverse environment
5. Visualization
    (a) Grammar of graphics
    (b) Introduction to ggplot environment

(c) Advanced graphics
6. Communicating results
(a) Markdown
(b) Quarto
(c) YAML

Part B: Introduction to Matlab

1. Why MATLAB?
2. Navigating MATLAB
(a) Installing and running MATLAB, using the interface
(b) How to find help
(c) Importing external packages
3. Scripts, Logic, and Loops
(a) Creating scripts
(b) Importing and exporting files and data (CSV, XLSX, mat etc)
(c) Matrices, operations, and basic MATLAB functions
(d) Logical operators
(e) Loops
(f) Creating functions
(g) Optimization
(h) Solutions, numerical differentiation and integration
(i) Simulation and Monte-Carlo
4. Creating Plots, Writing Good Code, Fixing Bad Code
(a) Creating, labeling and saving graphs
(b) Timing and writing efficient scripts
(c) Parallelization or parallel loops
(d) Common mistakes and how to fix them
5. Navigating across programming languages (calling Python or R from MATLAB)

Part C: Introduction to Academic Writing and Latex

1. Introduction to Academic Writing in Economics
(a) Introduction to Academic Writing in Economics
(b) Key elements: Abstract, Introduction, Literature Review, Methodology, Results, Conclusion
(c) Reading and analyzing exemplary papers
2. Research Design and Planning
(a) Formulating research questions and hypotheses
(b) Selecting appropriate methodologies
(c) Ethical considerations in economic research
3. Literature Review and Source Management
4. Writing and Publishing Strategies
(a) Drafting different sections of a paper
(b) Revising and editing techniques
(c) Understanding the peer-review process and selecting journals for publication
5. Introduction to LaTeX
(a) Getting started
(b) LaTeX features
(c) Presentations and drawings

Learning Outcomes

By the end of this course, students will:

• Develop proficiency in R for data science tasks, including data manipulation, and visualization.

• Gain foundational knowledge in MATLAB for economic modeling, numerical analysis, and data visualization.

• Acquire skills to plan and structure a high-quality academic paper in Economics.

Prerequisites

• Students are expected to bring their laptops for the course parts, introducing them to data science and MATLAB. Alternatively, and if needed, the computer class can be arranged.

Software used
This is a restricted list of various books that will be touched during the course.
• The MathWorks, Inc. (2024). Matlab [Version R2024a]. Natick, Massachusetts, United States. https: //www.mathworks.com/products/matlab.html
• John W. Eaton and others. (2024). Gnu octave [Version 9.2.0]. Boston, Massachusetts, United States. https://octave.org

Evaluation
The final grade for this course will consist of equally weighted grades from the 3 parts of the course:

Final Grade = Grade of Part A/3 + Grade of Part B/3 + Grade of Part C 3

• **The Grade of Part A** will consist of two parts: an assignment (40%) and a take-home exam (60%). An assignment: students will have to hand in an introduction of their own paper in economics. It does not have to be a finished paper, because the introduction will be evaluated based on clarity of the presentation, the idea and the structure only. Take-home exam: students will have to write a report on a given paper in economics. The report will be given a high grade, if it discusses the research question, the contribution and the structure. Including suggestions for improvement is required as well. Both parts will have to be delivered in LATEX.
• **The Grade of Part B** will consist of a take-home exam (100%): students will have to solve one take-home problem set, involving writing functions and doing simple data analysis in R.
• **The Grade of Part C** will consist of a take-home exam (100%): there will be one take-home problem set, involving the creation of MATLAB code that performs certain tasks and solves basic problems.

Main References

This is a restricted list of various books that will be touched during the course.

- Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). *R for data science*. O'Reilly Media, Inc. https://r4ds.hadley.nz/
- McCloskey, D. N. (1983). The rhetoric of economics. *Journal of economic literature*, *21* (2), 481–517
- McCloskey, D. (1985). Economical writing. *Economic Inquiry*, *23* (2), 187–222
- Gastel, B., & Day, R. A. (2022). *How to write and publish a scientific paper*. Bloomsbury Publishing USA

Supporting Material

- Dynare Team. (2024). *Dynare: A program for economic modeling and analysis* [Version 6.1]. Paris, France. https://www.dynare.org/
- Romer, D. (2019). *Advanced macroeconomics* (Fifth Edition). McGraw-Hill Education
- How to call MATLAB from R or python: https://nl.mathworks.com/videos/how-to-call-python-from- matlab-1571135771573.html
- MATLAB for central banks: https://nl.mathworks.com/solutions/finance-and-risk-management/central- banking.html
- Getting data from FRED: https://nl.mathworks.com/help/datafeed/fred.html
- Zinsser, W. K. (2016). *On writing well: The classic guide to writing nonfiction*. Harper Perennial
- Cochrane, J. (2005): Writing Tips for PhD Students, University of Chicago, https://www.johnhcochrane.com/research-all/writing-tips-for-phd-studentsnbsp