Course Manual
Introduction to Applied Data Science
2022-2023

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Course Description

Data Science is an emergent discipline growing faster due to the large amounts of data that we are generating, the maturity of information and communication technologies (ICT) and the high availability of high-end computational systems. Data Science works in the intersection between statistics, mathematics and computer programming. However, the key emphasis of Data Science is difference than the other disciplines. Statistics and Econometrics justify the development of algorithms primarily for inferential methods: parameter estimation for causal effect. However, in Data Science, the development of algorithms is justified to make more precise predictions and for complex problem-solving (Efron, 2021). Data Science and Machine Learning (ML) use powerful numerical methods and computer training to solve problems (Athey and Imbens, 2019). Data Science focuses on the one hand on how to process and interpret data to answer real-world questions. On the other hand, relies heavily on strong coding skills, to acquire, clean, manipulate and visualize data for analysis.

In this course, we develop these skills using the R-language, which has many advantages for Data Science. Firstly, is a free open-source computer language with a large community of Data Scientists, Economists and Statisticians working together to develop state-of-the-art algorithms and packages. Secondly, there is a large market of companies and universities that require knowledge of R. Thus, the main objective of this course is to introduce students with no prior knowledge of R-programming to tools and methods used in Data Science.

- This course features one weekly lecture (2 contact hours), and 1 tutorial (2 contact hours), and office hours, during which students can ask questions Thursday 16:00 - 17:00. You can also ask questions by e-mail.

Overview

Code	ECB1ID
Period	4
Timeslot	B (Tuesday Morning, Thursday Afternoon)
Level	1
ECTS	7.5
Course Type	Optimal Minor Course
Programme	BSc Economics & Business Economics
Department	U.S.E., Applied Economics
Coordinator/Lecturer	Bas Machielsen
Tutorial Teachers	Tba
Language	English

Course Materials

You don't need to buy any books for this course, but we use a couple of resources that you should read as a preparation for lectures/assignments. These are references materials that are regularly updated following the newest changes in the R community.

- R for Data Science: This book will teach you how to do data science with R: You'll learn how to get your data into R, get it into the most useful structure, transform it, visualize it and model it.
- RMarkdown Cookbook, which is designed to provide a range of examples on how to extend the functionality of your R Markdown documents.
- Happy Git With R: Happy Git provides opinionated instructions on how to install Git and get it working smoothly with GitHub, in the shell and in the RStudio IDE. It also contains a few key workflows that cover your most common tasks, and how to integrate Git and GitHub into your daily work with R and R Markdown.
- **Lecture Slides and Assignments** are available on Blackboard, but also here

Schedule and Syllabus

Event	Date	Subject	Materials
Lecture	1	Introduction to Data Science and Big Data	
Working Group	1	Setting up RStudio	
Lecture	2	Programming Basics	
Working Group	2	Using Tidyverse	
Lecture	3	Tables and Graphs	
Working Group	3	Getting Data, Visualizing and Summarizing	
Lecture	4	Programming Flow & Algorithms	
Working Group	4	Writing your own gradient descent	
Lecture	5	Debugging & Handling Errors	
Working Group	5	Debugging Strategies	
Lecture	6	Writing Reports in RMarkdown	
Working Group	6	Doing Data Analysis	
Lecture	7	Collaborating Effectively with Version Control	
Working Group	7	Creating and Changing a Github Repository	
Lecture	8	The Ethics of AI	

Event	Date	Subject	Materials
Working Group	8	Ethical Dilemmas	

Assignments

This course has three intermediate assignments. These will be uploaded to Blackboard, but they are also available [here]:

Assignment	Deadline
Assignment 1: Something	tba
Assignment 2: Something	tba
Assignment 3: Something	tba

Prerequisites

Mathematics, Statistics and introductory economics courses. This course is part of the Dedicated Minor in Applied Data Science for Economists. This is the first course, following which you will learn about:

- Introduction to Programming in R (ECB2PR, year 2, period 3)
- Data Analysis & Visualization I - Supervised Learning (ECB2ADAVE, year 2, period 4)
- Data Analysis & Visualization II - Unsupervised Learning (ECB3ADAVE2, year 3, period 1)
- Applied Microeconometric Techniques (year 3, period 2)
- Data Science Lab for Economics (year 3, period 3)

Learning Objectives

On effective completion of the course, students should:

- Understand principles of programming on an applied level
- Particularly, understand and be able to independently produce R code solving applied problems
- Being able to extrapolate the knowledge to other programming languages
- Gather, manipulate and wrangle untidy datasets
- Understand how to deal with errors and how to debug code
- Be able to read and exploit to their advantage code, package & function documentation
- Implement several elementary algorithms to solve concrete problems
- Be able to analyze and show results in a tidy and well-organized way
- Effectively collaborate together using version control
- Be able to reflect on the use of AI and Big Data in society

On successful attendance of the lectures, students should:

- have knowledge of the importance of Data Science and Machine learning.
- understand algorithmic thinking.
- understand the difference between causation and correlation
- be able to distinguish between descriptive, predictive, prescriptive and causal analysis.
- have awareness of the role of Data Science for Economics and its role in society.

Grading and Inspection

- The course will feature three individual assignments and one final exam. All assignments have to be handed in. The assignments have a weight of 60% and the final exam weight of 40% for the final grade. After the exam, students have the right to inspect their exam and assignment. Information about this will be announced in due time on Blackboard.

- All grades are rounded upward to two decimal places. Examples: 5.493 becomes 5.50, meaning *pass*, 5.490 becomes 5.49 meaning *fail*.

- If the final grade is below 5.50, there is a possibility of a resit, but only if the effort requirement is satisfied. No resit opportunity is possible for people obtained grades higher than 5.50.