

**Master in International and Development Studies**

Academic year 2022-2023

**Office hours**

Wednesdays, 15:00-17:00

P1-547

*No appointment needed*

**LECTURERS**

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**Fundamentals of R (A and B)**

**MINT WORKSHOP - Spring - 3 ECTS**

**Fundamentals of R (A)**

Friday 10th March, 14:15 to 18:00 (Block 1)

Friday 17th March, 14:15 to 18:00 (Block 2)

Friday 24th March, 14:15 to 18:00 (Block 3)

Friday 31st March, 14:15 to 16:00 (Lecture)

*All classes will be held in XXXXX.*

**Fundamentals of R (B)**

Friday 21st April, 14:15 to 18:00 (Block 1)

Friday 28th April, 14:15 to 18:00 (Block 2)

Friday 5th May, 14:15 to 18:00 (Block 3)

Friday 12th May, 14:15 to 16:00 (Lecture)

*All classes will be held in XXXXX.*

# Workshop Description

# R is a programming language and open-source software that allows users to import, transform, and analyze diverse types of data. Academics, governments, and industry use R data collection, data visualization, and data analysis. This workshop is a hands-on introduction to R, starting from scratch. In separate blocks, the workshop covers fundamental tasks in R as how to import different types of data; how to clean and manipulate objects; how to create beautiful visualizations; and how to get help from the community. The workshop presents topical case studies, which illustrate a practical application of the fundamentals of R, to cover key social science questions related to the environment, development finance, conflict, and democracies.

# Syllabus

**Workshop Format and Prerequisites**

The workshop format encompasses one online introductory session (pre-recorded), three blocks (duration 3 hours and 30 minutes), and one concluding session (1 hour and 45 minutes). Blocks are composed by a lecture, a practical session, and an applied case study.

This workshop assumes no prior knowledge of R software or programming. While this is not a statistics workshop and no prior statistics knowledge is required, knowledge of introductory statistics can be useful.

## Learning outcomes

By the end of this workshop, students should be able to (1) perform simple data analysis, (2) communicate findings with visualizations, and (3) produce integrated reports using R.

The workshop provides students with the basic tools so that they can continue independently with more complex tasks in R and leverage the community for help whenever necessary.

## Workshop Policies

Learning R can be f**R**ust**R**ating. This workshop is designed to allow proper time for each task and provide the necessary support to students.

This workshop is not reading extensive, but students are expected to spend time with the assignments and getting acquainted with R. Classes have suggested readings indicated in the workshop outline below and available in the workshop Moodle page.

The lecturers reserve the right to make alterations to this syllabus.

## Assessment

* *Attendance and participation (40%)*

Students should attend workshops and engage with peers.

* *Weekly homework (60%)*

Students should complete three small assignments in R to get acquainted with the software and internalize learning outcomes. Weekly assignments will be made available after the respective lecture they cover and be due before the following lecture.

## Workshop Materials

Students should try to have [R](https://www.r-project.org/) and [RStudio](http://www.rstudio.com) installed before the first block.

Class materials (readings, scripts, case studies, and presentations) will be available on the moodle page. Case studies will be designed and selected according to the student's interests.

While there is no required textbook for this workshop, we recommend the following books:

Douglas, A., Ross, D., Mancini, F., Couto, A. & Lusseau, D. (2022). [An Introduction to R](https://intro2r.com/).

Wickham, H., & Grolemund, G. (2017). [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)

Wickham, H. (2016). [ggplot2: Elegant Graphics for Data Analysis.](https://ggplot2-book.org/index.html)

Xie, Y., Allaire, J. J., & Grolemund, G. (2018). [R markdown: The definitive guide.](https://bookdown.org/yihui/rmarkdown/)

Mesquita, E. B., & Fowler, A. (2021). Thinking clearly with data: A guide to quantitative reasoning and analysis. Princeton University Press.

Healy, K. (2018). Data Visualisation: a practical introduction. Princeton University Press.

# WORKSHOP OUTLINE

**Introduction to R** (Pre-recorded Online Lecture)

We start our workshop by understanding what R is, how to install and open the software, and a few basic concepts.

* What is R language and software?
* What is R used for?
* How to interact with R studio?

*Suggested readings:*

* Thinking Clearly in a Data-Driven Age (Chapter 1) in Mesquita, E. B., & Fowler, A. (2021). Thinking clearly with data: A guide to quantitative reasoning and analysis. Princeton University Press.
* [Getting started with R and RStudio](https://intro2r.com/chap1.html) (Chapter 1) in Douglas, A., Ross, D., Mancini, F., Couto, A. & Lusseau, D. (2022). [An Introduction to R](https://intro2r.com/).
* Introduction and preliminaries (Chapter 1) in Venables, W. N., Smith, D. M., & R Development Core Team. (2022). [An introduction to R.](https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf)

**Block 1: Objects, functions, and data types**

R holds different objects with diverse classes. This lecture helps students understand what R classes are and how R functions operate in these. Moreover, we will learn how to properly get external data into R, one of the most important tasks new users should be able to perform. RStudio and several other R packages have made these tasks easier and more flexible.

* What are object classes and functions in R?
* How to perform arithmetic operations in R?
* How to import text (.csv) and excel (.xlsx) files to R?
* How explore newly imported data in R?

*Suggested readings:*

* [Some R basics](https://intro2r.com/basics_r.html) (Chapter 2) in Douglas, A., Ross, D., Mancini, F., Couto, A. & Lusseau, D. (2022). [An Introduction to R](https://intro2r.com/).
* [Data in R](https://intro2r.com/data_r.html) (Chapter 3) in Douglas, A., Ross, D., Mancini, F., Couto, A. & Lusseau, D. (2022). [An Introduction to R](https://intro2r.com/).
* Data import (Chapter 11) in Wickham, H., & Grolemund, G. (2017). [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)
* Simple manipulations; numbers and vectors (Chapter 2) in Venables, W. N., Smith, D. M., & R Development Core Team. (2022). [An introduction to R.](https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf)
* Grolemund, G., & Wickham, H. . (2011). Dates and Times Made Easy with lubridate. Journal of Statistical Software, 40(3), 1–25. <https://doi.org/10.18637/jss.v040.i03>
* Lists and data frames (Chapter 6) and Reading data from files (Chapter 7) in Venables, W. N., Smith, D. M., & R Development Core Team. (2022). [An introduction to R.](https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf)

**Block 2: Wrangling and cleaning data**

Data often does not come ready for the analysis you want to perform. Names within variables might not match (e.g. USA, US, United States), observations are missing (e.g. NA), among other human or programmatic coding errors. In this lecture, we will go through the fundamentals of (re)shaping data for our purposes using the [dplyr](https://dplyr.tidyverse.org/articles/dplyr.html) package.

* How to create and modify variables in data?
* How to group, filter, and summarise information contained in variables?
* How to merge multiple datasets?
* How to detect inconsistencies in data and harmonize strings?
* How to treat missing data?

*Suggested readings:*

* [Data transformation](https://r4ds.had.co.nz/transform.html) (Chapter 5) in Wickham, H., & Grolemund, G. (2017). [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)
* [Data Wrangling with dplyr in R](https://www.youtube.com/watch?v=L1kRVGv6NC8) (Gonzalez, K. 2021)
* [Regular Expressions](https://bookdown.org/rdpeng/rprogdatascience/regular-expressions.html) (Chapter 17) in Peng, R. D. (2022). [R programming for data science.](https://bookdown.org/rdpeng/rprogdatascience/)
* [Handling missing data in R](https://www.r-bloggers.com/2021/04/handling-missing-values-in-r/)
* Wickham, H. . (2014). Tidy Data. Journal of Statistical Software, 59(10), 1–23. <https://doi.org/10.18637/jss.v059.i10>
* Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D. A., François, R., & Yutani, H. (2019). [Welcome to the Tidyverse.](https://joss.theoj.org/papers/10.21105/joss.01686) Journal of open source software, 4(43), 1686.
* [Regular Expressions](https://stringr.tidyverse.org/articles/regular-expressions.html) with the [stringr](https://stringr.tidyverse.org/index.html) R package
* Van Buuren, S., & Groothuis-Oudshoorn, K. (2011). [mice: Multivariate imputation by chained equations in R.](https://www.jstatsoft.org/article/view/v045i03/0) Journal of statistical software, 45, 1-67.

**Block 3: Visualizations**

Visualizing your data is the bread and butter of any analysis you will perform. In this lecture, we will learn the principles of good data visualization with the [ggplot2](https://ggplot2.tidyverse.org/) package. We introduce how to create different types of plots in R as well as how to customize plots with trends, annotations, and labels to make them “tell a story”.

* How to create bar charts, scatter plots, box plots, and line trends?
* How to quickly visualize variation using facets?
* How to include trend lines in plots?
* How to plot multiple relationships between variables?
* How to annotate information to make plots more informative?

*Suggested readings:*

* visualization (Chapter 3) in Wickham, H., & Grolemund, G. (2017). [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)
* Look at the Data (Chapter 1) in Healy, K. (2018). Data visualization: a practical introduction. Princeton University Press.
* Graph Tables, Add Labels, Make Notes (Chapter 5) in Healy, K. (2018). Data visualization: a practical introduction. Princeton University Press.
* [First steps](https://ggplot2-book.org/getting-started.html) (Chapter 2) in Wickham, H. (2016). [ggplot2: Elegant Graphics for Data Analysis.](https://ggplot2-book.org/index.html)
* [Annotations](https://ggplot2-book.org/annotations.html) (Chapter 8) in Wickham, H. (2016). [ggplot2: Elegant Graphics for Data Analysis.](https://ggplot2-book.org/index.html)
* [Graphics for communication](https://r4ds.had.co.nz/graphics-for-communication.html) (Chapter 28) in Wickham, H., & Grolemund, G. (2017). [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)

**Exchanging with the community**

Now that you know the fundamentals, you will want to share results and ask for help. In this lecture, we will learn how to use R [Markdown](https://rmarkdown.rstudio.com/lesson-1.html) to export reproducible reports in different file formats (e.g. .pdf, .docx, and HTML). We will also discuss how to ask for help online using minimal reproducible examples.

* What is R Markdown?
* How to export integrated reports ready for sharing?
* How to create minimal reproducible examples?

*Suggested readings:*

* Introduction and Bomb Parts: What is a Model? (Chapter 1) in O'neil, C., 2016.Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway books.
* [Basics](https://bookdown.org/yihui/rmarkdown/basics.html) (Chapter 2) in Xie, Y., Allaire, J. J., & Grolemund, G. (2018). [R markdown: The definitive guide.](https://bookdown.org/yihui/rmarkdown/)
* [How to make a reprex?](https://www.r-bloggers.com/2020/10/how-to-make-a-reprex/)
* [R Markdown](https://r4ds.had.co.nz/r-markdown.html) (Chapter 27) in [R for data science: import, tidy, transform, visualize, and model data.](https://r4ds.had.co.nz/)
* [Weapons of Math Destruction](https://www.youtube.com/watch?v=TQHs8SA1qpk) (O’Neil, C. 2016)