A guide to writing a scientific paper using R

Research Methodologies 2024

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1 Use R to write a paper

Materials for the practical module **A guide to writing a scientific paper using R**, of the Research Methodologies in Natural and Social Sciences course of the PhD in Transport Systems at IST-ULisboa.

> **Note**
>
> This website was totally written in R using Quarto.

2 Software

In this chapter we will guide you through the installation of R, RStudio and the packages you will need for this course.

R and **RStudio**[1] are separate downloads.

2.1 R

R or **R stats** (how it is also known) is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing.

The download links live at The Comprehensive R Archive Network (aka CRAN). The most recent version is `4.4.1`, but you can use `>= 4.1.x` if you already have it installed.

2.1.1 Windows

Download R-4.4.2 for Windows and run the executable file.

> Important
>
> You will also need to install Rtools, which is a collection of tools necessary to build R packages in Windows.
> Select the second link if you use an ARM processor (more recent), and the first link otherwise.

2.1.2 Mac

Download R-4.4.2 for MacOX. You will have to choose between the arm64 or the x86-64 version.

Download the `.pkg` file and install it as usual.

[1] We will use RStudio, although if you already use other studio such as VScode, that's also fine.

2.1.3 Ubuntu

> These are instructions for Ubuntu. If you use other linux distribution, please follow the instructions on The Comprehensive R Archive Network - CRAN.

You can look for R in the Ubuntu **Software Center** or install it via the terminal:

```
# sudo apt update && sudo apt upgrade -y
sudo apt install r-base
```

Or, if you prefer, you can install the latest version of R from CRAN:

```
# update indices
sudo apt update -qq
# install two helper packages we need
sudo apt install --no-install-recommends software-properties-common dirmngr
# add the signing key (by Michael Rutter) for these repos
wget -qO- https://cloud.r-project.org/bin/linux/ubuntu/marutter_pubkey.asc | sudo tee -a /et
# add the R 4.0 repo from CRAN -- adjust 'focal' to 'groovy' or 'bionic' as needed
sudo add-apt-repository "deb https://cloud.r-project.org/bin/linux/ubuntu $(lsb_release -cs)
```

Then run:

```
sudo apt install r-base r-base-core r-recommended r-base-dev
```

[Optional] To keep up-to-date r version and packages, you can follow the instructions at r2u

After this installation, you don't need to open R base. Please proceed to install RStudio.

2.2 RStudio

RStudio Desktop is an integrated development environment (IDE) for R. It includes a console, syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management.

RStudio is available for free download from Posit RStudio.

2.2.1 Windows 10/11

Download RStudio 2024.09 and run the executable file.

2.2.2 MacOS

Download RStudio 2024.09 and install it as usual.

2.2.3 Ubuntu

> These are instructions for Ubuntu **24** / Debian 12. If you use other linux distribution, please follow the instructions on Posit RStudio.

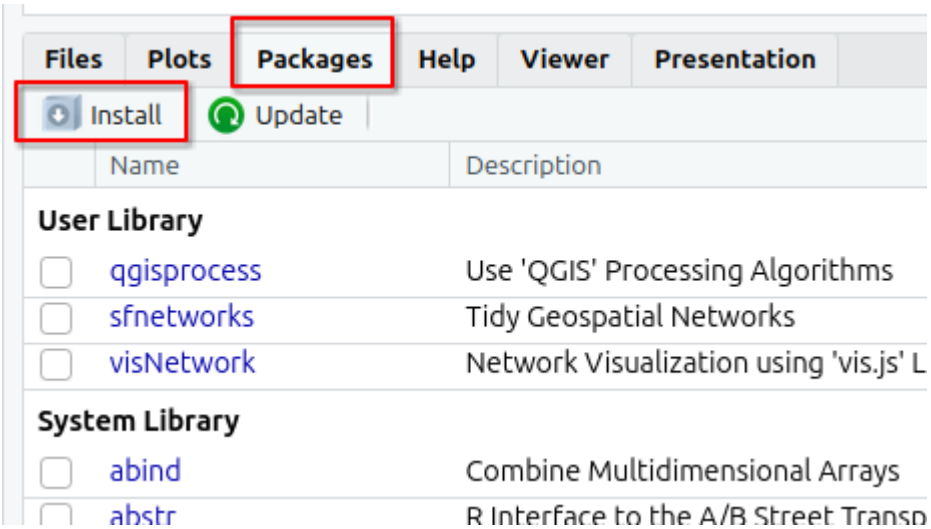
Install it via the terminal:

```
sudo apt install libssl-dev libclang-dev
wget https://download1.rstudio.org/electron/jammy/amd64/rstudio-2024.09.1-394-amd64.deb
sudo dpkg -i rstudio*
rm -v rstudio*
```

2.3 R packages

You will need to install some packages to work with the data and scripts in this course.

You can install them in RStudio by searching for them in the **Packages** tab:



or by running the following code in the console:

```
install.packages("rticles")

install.packages("tidyverse")
install.packages("readxl")

install.packages(c("remotes", "devtools", "usethis"))
```

2.4 rticles

You can install and use **rticles** from CRAN as follows:

```
install.packages("rticles")
```

See chapter 3 to setup an rticle template.

2.5 tinytex

To be able to **export** your Rmakdown document to a pdf file, you will need a LaTeX processor. `tinytex` is a low weight R package with the most used features of LaTeX that you can use with R.

```
# you need to run both lines
install.packages("tinytex")
tinytex::install_tinytex()
```

To use some LaTeX packages, you also need to install some `tlmgr` packages. Here is a list of the most common ones.

```
tinytex::tlmgr_install(c("algorithmicx", "algorithms", "amscls", "amsfonts", "amsmath", "apa

tinytex::tlmgr_update() # updates all latex pkgs
```

> **Note**
>
> This may take a bit longer for the first time.

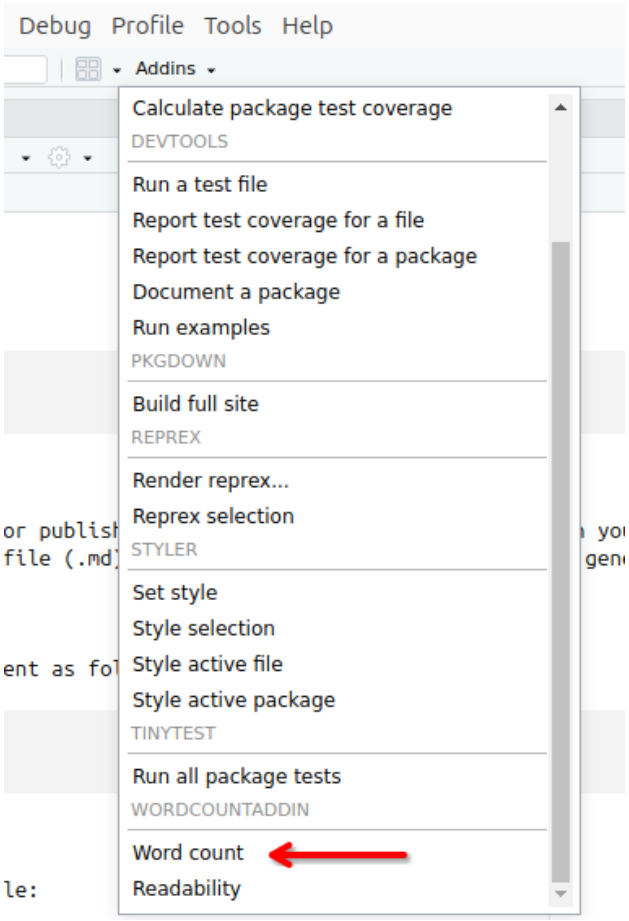
2.6 Word count addin

This R package is an RStudio addin to count words and characters in text in an R markdown document. It also has a function to compute readability statistics so you can get an indication of how easy or difficult your document is to read.

Install with:

```
devtools::install_github("benmarwick/wordcountaddin",
                         type = "source", dependencies = TRUE)
```

Close and reopen RStudio so the WordCountAddin should be available under Addins.



2.7 Zotero

Zotero is a free reference and bibliography manager, just like *Mendley* and others.

You can use Zotero to organize your papers, and to create automatic in-line citations and references.

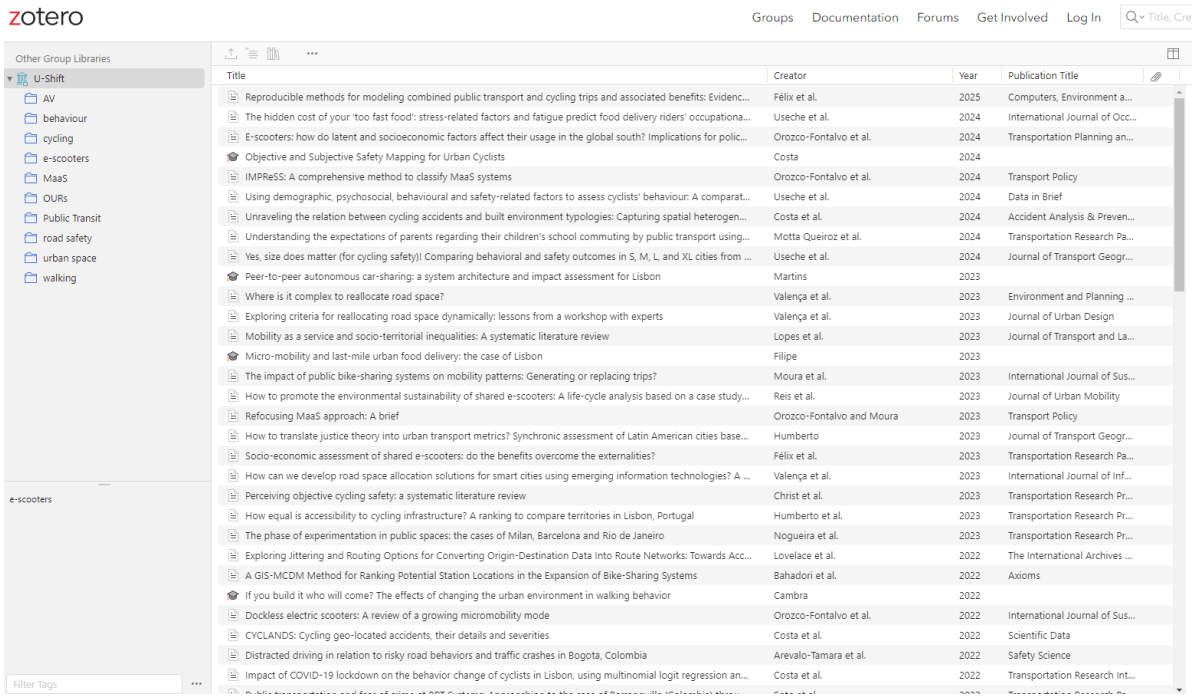
To **download**, please visit https://www.zotero.org/download/ and select you operating system.

You may need to register for a free account at https://www.zotero.org/user/register

2.7.1 Shared libraries

An interest thing in Zotero is that you can share a bibliography collection with others, for instance your research group or lab, and even those collections can be divided in sub-folders. And in that case, you can benefit from the readings of your colleagues.

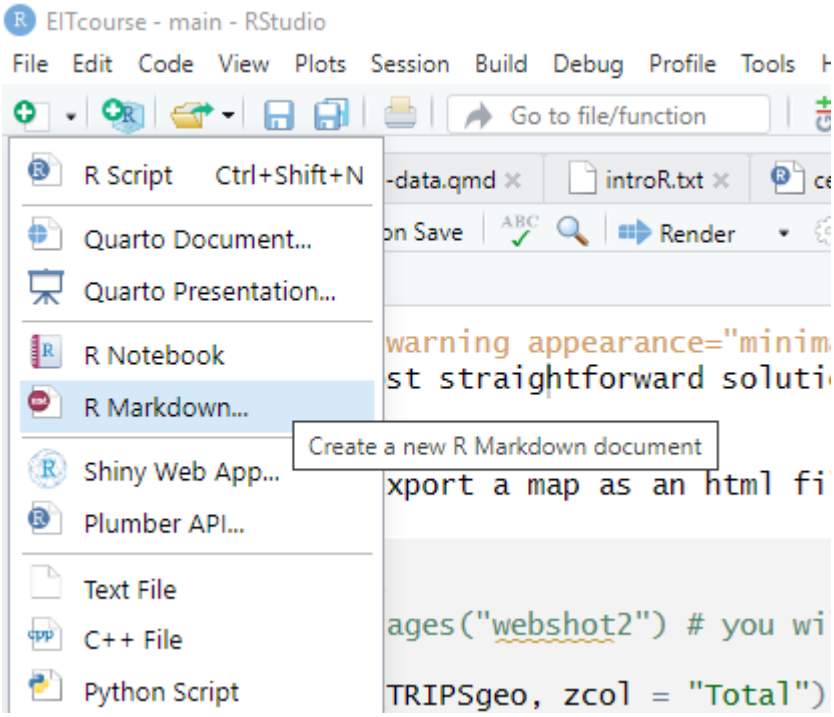
See the U-Shift Zotero collection, for instance.:



> **i** Keep in mind that automatic fields of references **may need some adjustments**. Always double check if the fields seem to be correct.

3 Using Rmarkdown

ewew



4 Setup a paper with styles

We can write an academic paper using R Studio.

You don't need to know everything by heart. Starting with a pre-defined template is usually the best way to go.

See the examples of journal's templates at https://pkgs.rstudio.com/rticles/articles/examples.html

To use **rticles** from RStudio, you can access the templates through `File -> New File -> R Markdown`. This will open the dialog box where you can select from one of the available templates:

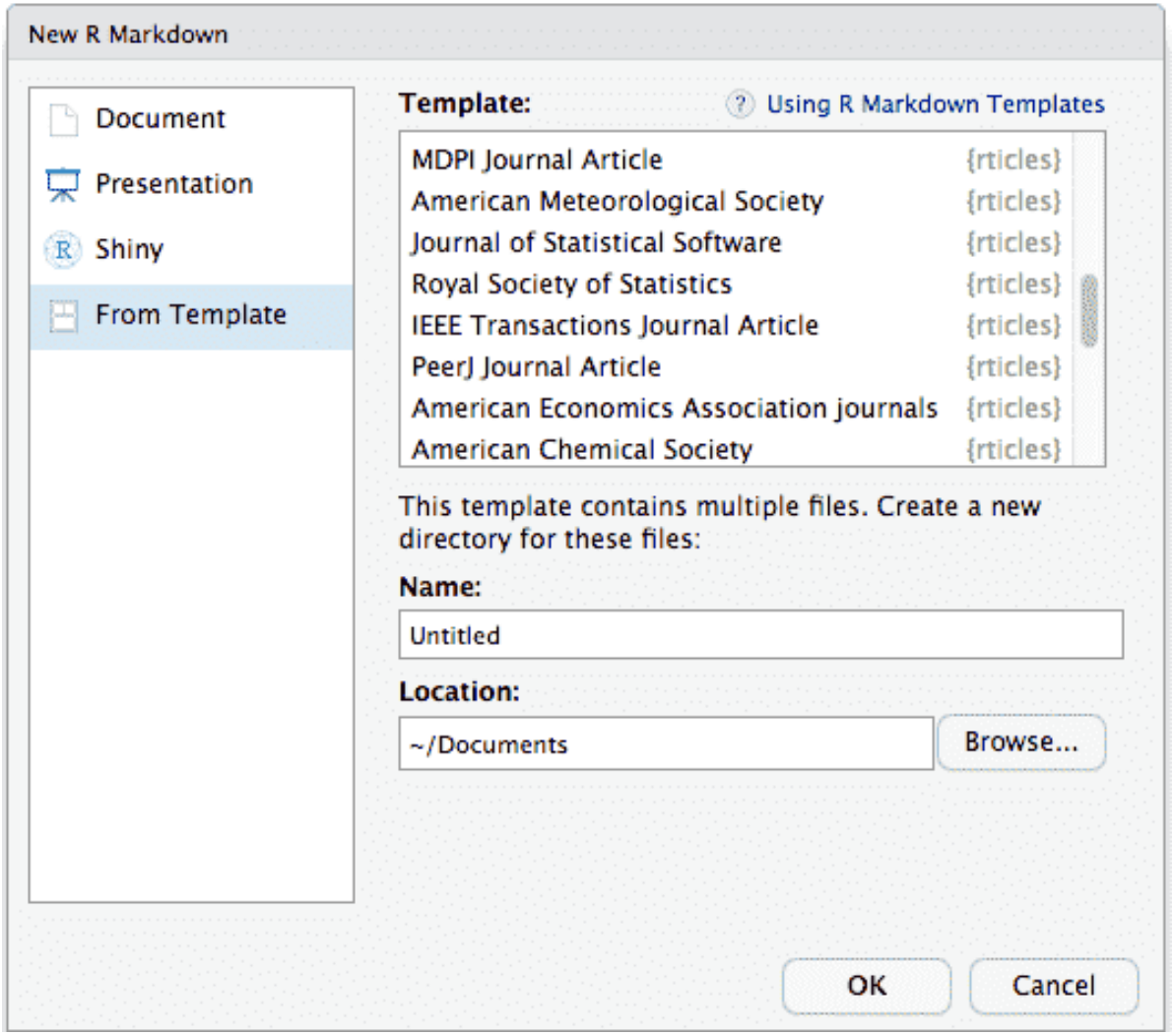


Figure 4.1: New R Markdown

Let's start by choosing the Elsevier template, and provide a name to your paper (this will also be the name of the folder).

About

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Short bio

Rosa Félix is a senior post-doctoral researcher at the Instituto Superior Técnico – University of Lisbon and member of the U-Shift lab, in the Transportation Research Group of CERIS. Having a background of Urban Planning Engineering, she completed her Ph.D. in Transport Systems in 2019 at Instituto Superior Técnico (MIT Portugal program), and was a Visiting Scholar at Portland State University in 2017/18.

Rosa is an active mobility researcher, and excels in R and GIS. She is an open source and reproducible research enthusiast. Her publications include articles on cycling and behavior change, and open source code solutions to specific GIS and mobility problems. Every year, Rosa lectures a course for cycling infrastructure planning and design for practitioners, and also teaches GIS for transportation and introduction to programming for MSc course of Transportation Systems.

Rosa has worked in multiple R&D and consultancy projects with both municipalities and industry, such as the Municipality of Lisbon (2019-2022) and the Department for Transportation of Lisbon Metro (2023), in which she developed a digital tool - *biclaR* - to support the planning of the metropolitan cycling network, in collaboration with Institute for Transport Studies of the University of Leeds.