

# Good practice R coding

Day 1 - Introduction to Data Analysis with R

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# Chaotic projects and workflows ...

... can make even small changes frustrating and difficult.



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# Background

Often, we want to **share** and **publish** our projects.

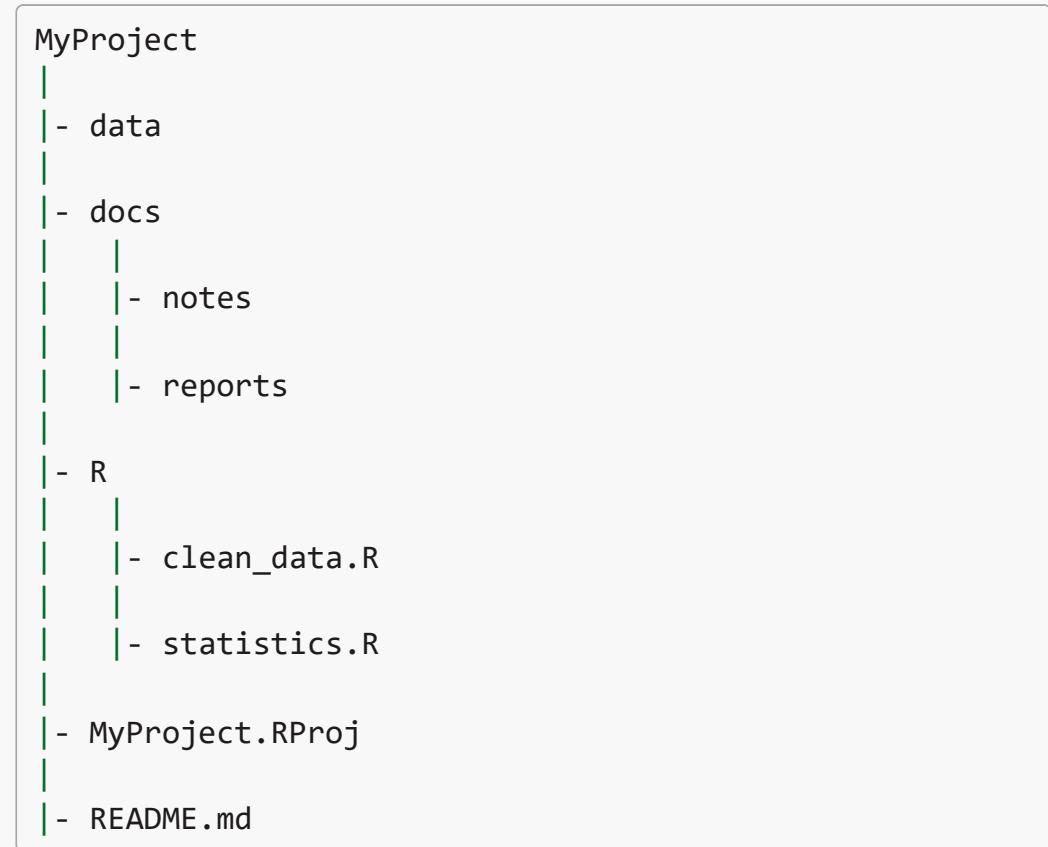
- **Reproducibility** 
  - Can someone else reproduce my results?
- **Reliability** 
  - Will my code work in the future?
- **Reusability** 
  - Can someone else actually use my code?

# Set up your project properly

Consistent structure and filenames

# Have a clear project structure

- One directory with all files relevant for project
  - Scripts, data, plots, documents, ...
- Choose a meaningful project structure<sup>1</sup>
- Add a readme file (usually `README.md`) in which you document the project structure



Example RStudio project structure

1. you can orient yourself at the [R package structure](#)

# Use RStudio projects

Always make your project an RStudio Project (if possible)!

-  You already did that.

# Set up your project

R Studio offers a lot of settings and options.

So have a  and check out **Tools -> Global Options** and all the other buttons.

- [R Studio cheat sheet](#) that explains all the buttons
- Update R Studio from time to time to get new settings ([Help -> Check for Updates](#))

# Name your files properly

Your collaborators and your future self will love you for this.

## Principles <sup>1</sup>

File names should be

1. Machine readable
2. Human readable
3. Working with default file ordering

1. From [this talk](#) by J. Bryan

# 1. Machine readable file names

Names should allow for easy **searching**, **grouping** and **extracting information** from file names.

- No space & special characters

## Bad examples ✗

-  2023-04-20 temperature göttingen.csv
-  2023-04-20 rainfall göttingen.csv

## Good examples ✓

-  2023-04-20\_temperature\_goettingen.csv
-  2023-04-20\_rainfall\_goettingen.csv

## 2. Human readable file names

Which file names would you like to read at 4 a.m. in the morning?

- File names should reveal the file content
- Use separators to make it readable

Bad examples 



Good examples 



### 3. Default ordering

If you order your files by name, the ordering should make sense:

- (Almost) always put something numeric first
  - Left-padded numbers (`01`, `02`, ...)
  - Dates in `YYYY-MM-DD` format

#### Chronological order

-  `2023-04-20_temperature_goettingen.csv`
-  `2023-04-21_temperature_goettingen.csv`

#### Logical order

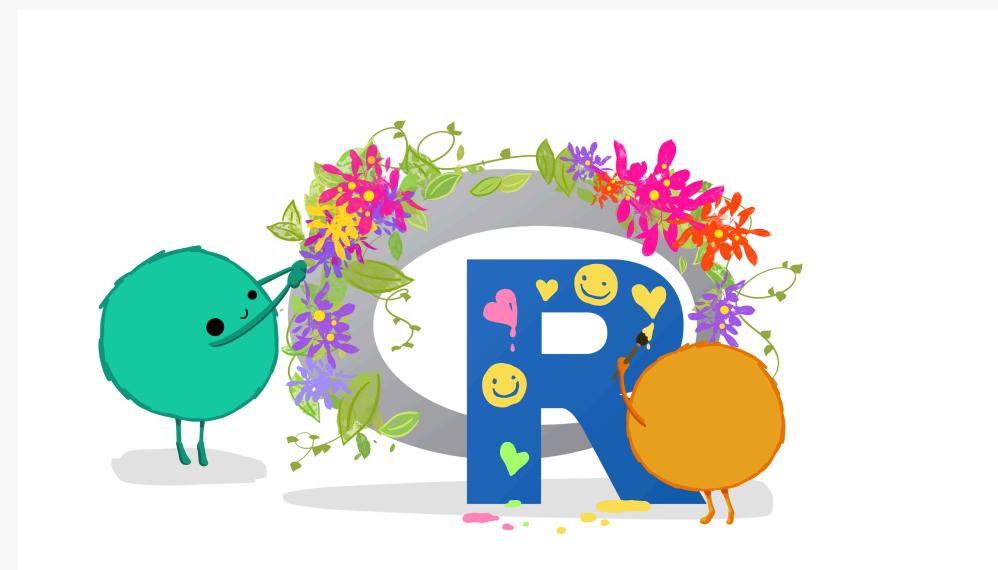
-  `01_prepare-data.R`
-  `02_lm-temperature-trend.R`

# Let's start coding

Good practice R coding

# Write beautiful code

- Try to write code that others (i.e. future you) can understand
  - Follow standards for readable and maintainable code
    - For R: [tidyverse style guide](#) defines code organization, syntax standards,
- ...



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# Standard code structure

1. General comment with purpose of the script, author, ...
2. `library()` calls on top
3. Set default variables and global options
4. Source additional code
5. Write the actual code, starting with loading all data files

```
# This code replicates figure 2 from the
# Baldauf et al. 2022 Journal of Ecology
# paper.
# Authors: Selina Baldauf and Jane Doe
# Copyright Selina Baldauf (2024)

library(tidyverse)
library(vegan)

# set defaults
input_file <- "data/results.csv"

# source files
source("R/my_cool_function.R")

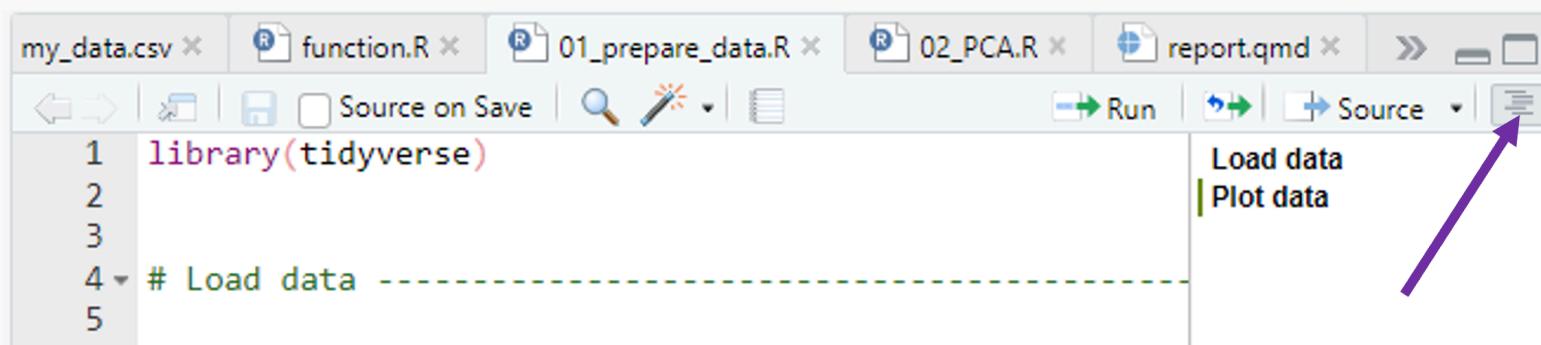
# read input
input_data <- read_csv(input_file)
```

# Mark sections

- Use comments to break up your file into sections

```
# Load data -----  
  
input_data <- read_csv(input_file)  
  
# Plot data -----  
  
ggplot(input_data, aes(x = x, y = y)) +  
  geom_point()
```

- Insert a section label with **Ctrl/Cmd + Shift + R**
- Navigate sections in the file outline



# Break down large scripts

- If your scripts become too big, split them
- You can use `source()` in R to load the content of another script
  - You can source the same script into multiple other scripts

`R/analyse_species.R:`

```
# This code ....  
# Authors: Selina Baldauf and Jane Doe  
# Copyright Selina Baldauf (2024)  
  
library(tidyverse)  
library(vegan)  
  
# source file for data reading  
# and cleaning  
# output is the tibble species_clean  
source("R/prepare_data/read_and_clean_data.R")  
  
# Analyse species data -----  
  
# Here code for the analysis
```

`R/prepare_data/read_and_clean_data.R`

```
# Script to read and prepare  
# species data and clean it  
  
path_to_species <- "data/species.csv"  
  
species_raw <- read_csv(path_to_species)  
  
# further code for cleaning the data
```

# Coding style - Object names

- Variables should only have *lowercase letters, numbers, and \*\_\**
- Use **snake\_case** for longer variable names
- Try to use concise but meaningful names

```
# Good
day_one
day_1

# Bad
DayOne
dayone
first_day_of_the_month
dm1
```

# Coding style - Spacing

- Always put spaces after a comma

```
# Good  
x[, 1]
```

```
# Bad  
x[, 1]  
x[, 1]  
x[, 1]
```

# Coding style - Spacing

- Always put spaces after a comma
- No spaces around parentheses for normal function calls

```
# Good
mean(x, na.rm = TRUE)

# Bad
mean(x, na.rm = TRUE)
mean(x, na.rm = TRUE)
```

# Coding style - Spacing

- Always put spaces after a comma
- No spaces around parentheses for normal function calls
- Spaces around most operators (<- , == , + , etc.)

```
# Good
height <- (feet * 12) + inches
mean(x, na.rm = TRUE)
```

```
# Bad
height <- feet * 12 + inches
mean(x, na.rm = TRUE)
```

# Coding style - Spacing

- Always put spaces after a comma
- No spaces around parentheses for normal function calls
- Spaces around most operators (<-, ==, +, etc.)
- Spaces before pipe (|>) followed by new line

```
# Good
iris |>
  summarize_if(is.numeric, mean, .by = Species) |>
  arrange(desc(Sepal.Length))

# Bad
iris |>
  summarize_if(is.numeric, mean, .by = Species) |>
  arrange(desc(Sepal.Length))
```

# Coding style - Spacing

- Always put spaces after a comma
- No spaces around parentheses for normal function calls
- Spaces around most operators (`<-`, `==`, `+`, etc.)
- Spaces before pipe (`|>`) followed by new line
- Spaces before `+` in ggplot followed by new line

```
# Good
ggplot(aes(x = Sepal.Width, y = Sepal.Length, color = Species)) +
  geom_point()

# Bad
ggplot(aes(x = Sepal.Width, y = Sepal.Length, color = Species)) + geom_point()
```

# Coding style - Line width

Try to limit your line width to 80 characters.

- You don't want to scroll to the right to read all code
- 80 characters can be displayed on most displays and programs
- Split your code into multiple lines if it is too long
  - See this grey vertical line in R Studio?

```
# Bad
iris |>
  summarise(
    Sepal.Length = mean(Sepal.Length),
    Sepal.Width = mean(Sepal.Width),
    Species = n_distinct(Species),
    .by = Species
  )

# Good
iris |>
  summarise(
    Sepal.Length = mean(Sepal.Length),
    Sepal.Width = mean(Sepal.Width),
    Species = n_distinct(Species),
    .by = Species
  )
```

# Coding style

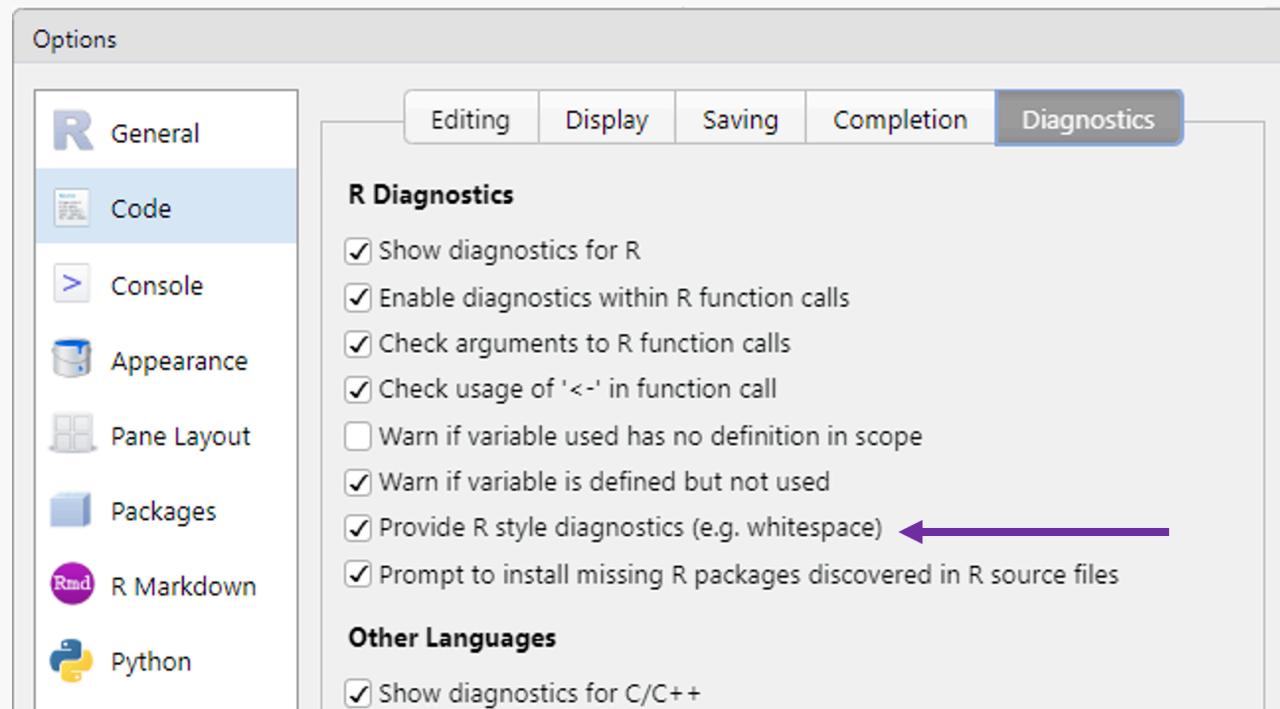
Do I really have to remember all of this?

Luckily, no! R and R Studio provide some nice helpers

# Coding style helpers - RStudio

RStudio has style diagnostics that tell you where something is wrong

Tools -> Global Options -> Code -> Diagnostics



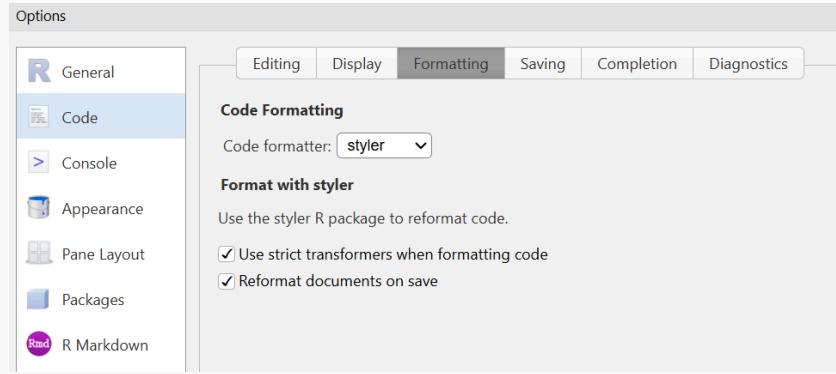
The screenshot shows a code editor window with R code. Lines 11 through 15 are shown:

```
10
11 data<-data %>%
12   group_by( group ) %>%
13   summarize(
14     measure=mean(measure,na.rm=TRUE)
15   )
```

A tooltip box appears over line 14, reading "expected whitespace around '=' operator".

# Coding style helpers - Auto-formatting

RStudio can automatically format your code!



# Coding style helpers - Linting

- Linters are tools that analyze your code for potential errors
- The R package `lintr` is a linter for R code
  - Install it with `install.packages("lintr")`
- Open the command palette with `Ctrl/Cmd + Shift + P` and search for “lint”
  - “Lint current file” to lint the open script
  - This will print a list of potential improvements in the console area



# Let's share

Publish or share your analysis

# Make your code sharable

- Use relative paths!
- Make sure you include all necessary files
- Include a readme with instructions on how to run the code and an explanation of the project structure
- Comment your code to make it understandable



## Send your code to a colleague

If you are unsure if your code is understandable and can run on another machine, send it to a colleague and ask them to run it and give you feedback

# Publishing your code

- Include a licence
  - Choose a licence (common for open source projects: MIT, GPL-3.0)
  - Use the `usethis` package to add a licence to your project
    - `install.packages("usethis")`
    - `usethis::use_mit_license("Your Name")` adds a licence file to your project
- Show which packages and which versions you used
  - this is important for reproducibility as packages change over time
  - `devtools::session_info()` prints a list of all packages and their versions (add this to your readme file)
  - `renv` is a package that helps you manage package versions
- Consider learning Git and publish on GitHub/Gitlab etc.

# Clean projects and workflows ...

... allow you and others to work productively.

But don't get overwhelmed by all the advice. Just start with one thing.



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