

# ETC4500/ETC5450

## Advanced R programming

Week 3: R package development



# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website
- 6 Continuous integration
- 7 Exercise

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website
- 6 Continuous integration
- 7 Exercise

# System setup

```
install.packages(c("devtools", "roxygen2", "testthat", "knitr"))
```

# System setup

```
install.packages(c("devtools", "roxygen2", "testthat", "knitr"))
```

## R build toolchain

- Windows:

<https://cran.r-project.org/bin/windows/Rtools/>

- macOS: `xcode-select --install`

- Linux: `sudo apt install r-base-dev`

# System setup

```
install.packages(c("devtools", "roxygen2", "testthat", "knitr"))
```

## R build toolchain

- Windows:

<https://cran.r-project.org/bin/windows/Rtools/>

- macOS: `xcode-select --install`

- Linux: `sudo apt install r-base-dev`

## Verify

```
library(devtools)  
dev_sitrep()
```

# Package states

- **source**: the original files
- **bundled**: some processing, and compressed to a single `.tar.gz` file (e.g., to upload to CRAN)
- **binary**: what you usually download from CRAN
- **installed**: decompressed binary file stored in package library
- **in-memory**: loaded into R session using `library()`

# Package states





# Package structure



There are multiple packages useful to package development, including **usethis** which handily automates many of the more repetitive tasks. Install and load **devtools**, which wraps together several of these packages to access everything in one step.

# Package name

- Only letters, numbers and periods.
- Must start with a letter.
- It cannot end with a period.
- No hyphens or underscores.
- Use the `available::available()` function to try ideas.

# Package code is different

- The DESCRIPTION file is the principal way to declare dependencies; we don't do this via `library(somepackage)`.
- Be explicit about which functions are user-facing and which are internal helpers. By default, functions are not exported.

## Exercise: Start on a package

We will create a package that doubles numbers.

- 1 Create a new folder with package name and setup project file.
- 2 Create package skeleton

```
create_package()
```

# Workflow



# Workflow shortcuts

- `install()` : Ctrl-Shift-B
- `load_all()` : Ctrl-Shift-L
- `document()` : Ctrl-Shift-D
- `check()` : Ctrl-Shift-E
- `test()` : Ctrl-Shift-T

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website
- 6 Continuous integration
- 7 Exercise

# DESCRIPTION file

Package: doubler

Title: This package doubles numbers

Version: 0.0.0.9000

Authors@R:

```
  person("Rob", "Hyndman", , "Rob.Hyndman@monash.edu", role = c("aut", "cre"))
```

Description: Whether the input is real, complex or character, this will double it.

License: GPL (>= 3)

Encoding: UTF-8

Roxygen: list(markdown = TRUE)

RoxygenNote: 7.3.1

Suggests:

```
  testthat (>= 3.0.0)
```

Config/testthat/edition: 3



# DESCRIPTION file

- **Title:** one line description. Plain text, title case, no more than 65 characters.
- **Description:** Several sentences, one paragraph. 80 characters per line, 4 space indentation. Don't include the package name in the Title or Description. Do not start with "This package does..."
- **Author:** Use `Authors@R` with `person()` for each author.
- **Version.** `Major.Minor.Patch.9000`. The 9000 is a placeholder for development versions.
- **License:** GPL-3 or MIT are common.

## DESCRIPTION file

- **Depends:** packages that are attached with your package. (Not needed for most packages.)
- **Imports:** packages that are used in your package. (Refer to functions using `pkg::fun()`.)
- **Suggests:** packages that are used in your package, but not required. (E.g., in tests or examples.)
- **LazyData:** `true` prevents users having to use `data()`.

# DESCRIPTION file

Functions to help with the DESCRIPTION file:

- `use_github()` or `use_github_links()`: set the GitHub repository, URL and BugReports.
- `use_mit_license()`: set the license to MIT.
- `use_gpl3_license()`: set the license to GPL-3.
- `use_package()`: Add package to Imports or Suggests.
- `use_data()`: Add data to your package.
- `use_tidy_description()`: Clean up the DESCRIPTION file.

# NAMESPACE file

- Generated by `roxygen2`, so don't edit by hand.
- `export()`: export a function (including S3 and S4 generics).
- `S3method()`: export an S3 method.
- `importFrom()`: import selected object from another namespace (including S4 generics).
- `import()`: import all objects from another package's namespace.
- `useDynLib()`: registers routines from a DLL (this is specific to packages with compiled code).

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation**
- 4 Tests
- 5 Website
- 6 Continuous integration
- 7 Exercise

# Documenting the package

```
use_package_doc()
```

# Documenting functions

- Add roxygen2 comments to your .R files
  - ▶ RStudio menu: Code > Insert roxygen skeleton (while cursor is within function)
  - ▶ Or use Github Copilot (in RStudio or VS-Code)
  - ▶ Or write them by hand
- Then use `document()` to generate the Rd files and the NAMESPACE file. (Or press `Ctrl+Shift+D` in RStudio.)
- Preview documentation with `?function`

# Documenting functions

```
#' Title
#'  
#' Description  
#' More description  
#'  
#' @param x Description of x  
#' @inheritParams fun  
#' @returns Description of return value  
#' @examples  
#' @importFrom pkg fun  
#' @import pkg  
#' @rdname fun  
#' @aliases fun  
#' @seealso fun  
#' @references Some reference  
#' @author Your name  
#' @export
```



# Documenting data

- Put raw data in data-raw/
- Code to wrangle data and create objects in data-raw/
- `use_data(object)` to add rda to data/

```
#' Title
#'  
#' Description  
#' More description  
#'  
#' @source Where did you get the data?  
#' @format Class, dimensions, or other details  
#' @keywords datasets  
#' @examples  
"object"
```

# README.Rmd

- 1 Describe the high-level purpose of the package.
- 2 A simple example illustrating package.
- 3 Installation instructions
- 4 An overview of the main components of the package.
  - Like a short vignette
  - Displayed on the Github repository and the front page of the pkgdown site.
  - Create with `usethis::use_readme_rmd()`
  - Build with `devtools::build_readme()`

- A long-form guide to your package, or an extended example.
  - ▶ `usethis::use_vignette("my-vignette")`
  - ▶ Creates a `vignettes/` directory.
  - ▶ Adds the necessary dependencies to `DESCRIPTION`
  - ▶ Drafts a vignette, `vignettes/my-vignette.Rmd`.
  - ▶ Adds some patterns to `.gitignore`

# Vignettes YAML

```
---  
title: "Vignette Title"  
author: Your name  
output: rmarkdown::html_vignette  
vignette: >  
  %\VignetteIndexEntry{Vignette Title}  
  %\VignetteEngine{knitr::rmarkdown}  
  %\VignetteEncoding{UTF-8}  
---
```

# Vignettes initial code chunks

```
```{r, include = FALSE}  
knitr::opts_chunk$set(  
  collapse = TRUE,  
  comment = "#>"  
)  
```
```

```
```{r setup}  
library(yourpackage)  
```
```

- Any package used in a vignette must be included in Suggests if not already in Imports.

- List changes in each release that users might care about.
- Use `usethis::use_news_md()` to create a `NEWS.md` file.

```
# foofy (development version)

★ Better error message when grooving an invalid grobble (#206).

# foofy 1.0.0

## Major changes

★ Can now work with all grooveable grobbles!

## Minor improvements and bug fixes

★ Printing scrobbles no longer errors (@githubusername, #100).

★ Wobbles are now 55% less jibbly (#200).
```

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests**
- 5 Website
- 6 Continuous integration
- 7 Exercise

- `usethis::use_testthat()`
  - ▶ Create a `tests/testthat/` directory.
  - ▶ Add `testthat` to the `Suggests` field in `DESCRIPTION` and specify `testthat >= 3e` in the `Config/testthat/edition` field.
  - ▶ Create a file `tests/testthat.R` that runs all your tests when `check()` runs.
- Every exported function should have tests.
- `usethis::use_test("some_tests.R")` creates a test file for a function or group of functions.
- Each R file should match a test file.



- Test files live in `tests/testthat/` and are named `test-*.R`.
- Each test file should test one function or a small group of related functions.
- Useful testing functions:
  - ▶ `expect_equal()`, `expect_identical()`, `expect_true()`, `expect_false()`
  - ▶ `expect_error()`, `expect_warning()`, `expect_message()`
- `test()` runs all tests.

# What to test

- Focus on testing the exported functions.
- Strive to test each behaviour in one and only one test.
- Avoid testing simple code that you're confident will work.
- Always write a test when you discover a bug.
- The test-first philosophy: always start by writing the tests, and then write the code that makes them pass.
- Use `devtools::test_coverage()` to see which parts of your package are tested.

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website**
- 6 Continuous integration
- 7 Exercise

# pkgdown websites

- `usethis::use_pkgdown()`
  - ▶ Creates `_pkgdown.yml` to configure site.
  - ▶ Updates `.Rbuildignore`
  - ▶ Adds docs to `.gitignore`
- `pkgdown::build_site()` to build the site.
- `usethis::use_pkgdown_github_pages()` to publish the site via GitHub Actions and GitHub Pages.
- Make a hex sticker with the `hexSticker` package.
- Add it using `usethis::use_logo()`.

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website
- 6 Continuous integration**
- 7 Exercise

# Github Actions

- Some development tasks can be executed automatically on Github with a trigger (e.g., a push)
- Run R CMD check:  
`usethis::use_github_action("check_standard")`
- Compute test coverage:  
`usethis::use_github_action("test-coverage")`
- Build and deploy pkgdown site:  
`usethis::use_github_action("pkgdown")`
- The `.github/workflows/` directory contains action files.
- See <https://github.com/r-lib/actions/> for more examples.

# Outline

- 1 Getting started
- 2 Package metadata
- 3 Documentation
- 4 Tests
- 5 Website
- 6 Continuous integration
- 7 Exercise

# Exercise

- If you haven't finished Assignment 1, do it now.
- If you have finished Assignment 1, create an R package that includes `remaining_customers` as the only function. Add unit tests, a readme file, and a pkgdown website.