R packages

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What is a package?

- A compressed file
- Contains all of the files required to distribute R code

Why create a package?

- The best way to distribute **R** code
- Makes your code reproducible
- makes code reusable
- improves code quality
- takes care of dependencies
- self-documenting
- should work for anyone, on any computer

Building a package

- All components are text files
- You could build them manually
- **DON'T!**
- Use the package **devtools**
- makes it *much* easier
- Also, install packages **roxygen2, rmarkdown**
- Need LaTex installed to create manuals
- Also, make sure to have **git** installed on your system

Mandatory package components

- 2 Files
- DESCRIPTION
- NAMESPACE
- 2 directories are mandatory
- /R – contains code .R files
- /man – contains documentation .Rd files
- may have other directories

DESCRIPTION

- Contains package description
- Has to have a specific format
- Has to indicate the packages required by your package

DESCRIPTION example

```
Package: WISKIr
Title: Acquires data from a WISKI web server
Version: 2.1.5
Date: 2017-12-01
Author: Kevin Shook, Centre for Hydrology, University of Saskatchewan
Maintainer: Kevin Shook <kevin.shook@usask.ca>
Description:  Functions to acquire a) the set of time series for a station, b)
    the metadata for a specific times series, c) the values for a specified time
    series over a specified range of dates.
Depends: R (>= 3.3)
Imports: stringr (>= 1.0)
License: GPL-3
URL: www.usask.ca/hydrology
```

NAMESPACE

- Contains detailed information about imports and exports of each function
- Do NOT create or edit this file
- **roxygen2** will automatically create and maintain it

R directory

- Contains the R code
- Code must be written as functions
- Each function must be in a separate file
- file name is same as function name
- file extension must be **.R**

man directory

- Contains the documentation files

- Creates the help system for the package
- Also creates the manual
- Each .R file has a .Rd file in **man**
- Don't create these files manually

roxygen2

- Used by **devtools**, installed by it
- Automatically creates the .Rd files
- uses comments at the beginning of each .R file

Example

- All lines begin with #'
- First line contains a 1 line description of the file
- Should not end with a period!
- Example:
  #' Calculates quantile values for a Quantile-Quantile plot

- All other lines have a tag beginning with **@**

Tags

```
#' @description - optional multi-line desciption
#' @param - required for each parameter
#' @return - required, specifies return value of function
#' @author - optional, lists author
#' @export - required if function is accessible outside your package
#' @examples - required, a working example
```

Formatting

- Documentation can include formatting codes

```
\pkg{} - package
\option{} - option
\emph{} - emphasis
\code{} - code
```

Example

```
#' Calculates quantile values for a Quantile-Quantile plot
#' @description The built-in \code{qqplot} function does not work with \pkg{ggplot2}. This
#' @param x Required. A numeric vector.
#' @param y Required. A numeric vector.
#' @return Returns a dataframe with the quantiles of x and y.
#' @author Kevin Shook
#' @export
#' @examples
#' quantiles <- qqplotValues(runif(20), runif(50))
```

Package function

- You should create a function that has the name of your package
- Example: WISKIr-package.R
- Contains information to create NAMESPACE

Example

```
#' @title Contains functions to extract data from a Kisters WISKI web server.
#' @docType package
#' @name WISKIr-package
#' @description ...
#' @references ...
#' @import stringr utils
NULL
```

Other folders

- You may see these folders in packages:
- /data, data files used by the package
- /vignettes, documentation written in Markdown
- /inst, contains the file CITATION showing how to cite the package
- /src, source code written in C, C++ or Fortran

Workflow

1. Create the packae

2. Add code
3. Build package
4. Check package
5. Create package file
6.

Creating the package

- Create a new project in a new directory

- **File|New Project**
- select **R Package**
- then give your package a name and a location
- Make sure to use git!

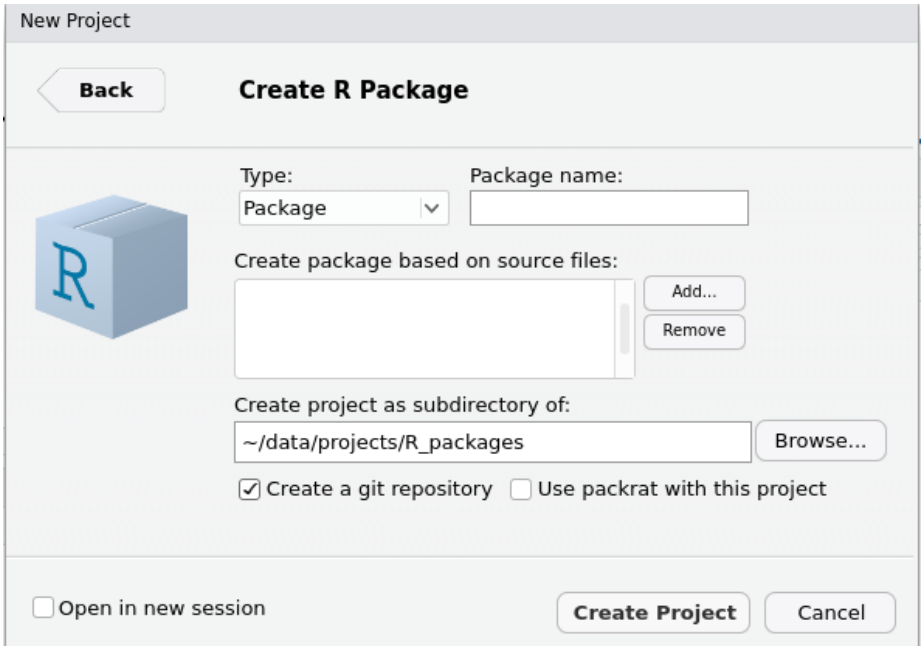


Figure 1:

New package

- R studio will create all of the files and directories
- /R
- /man
- DESCRIPTION
- NAMESPACE
- Also creates a sample file **hello.R** in /R
- Adds folders and files for git

Setting up roxygen

- Not enabled by default
- Set it up using **Tools|Project Options**

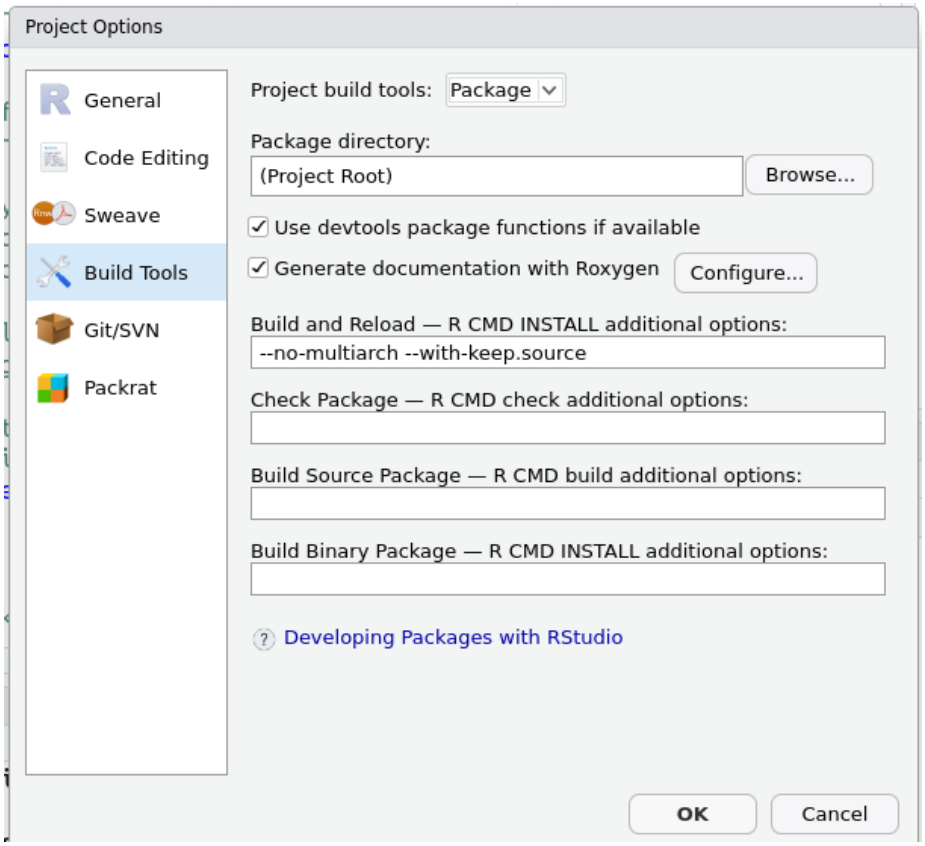
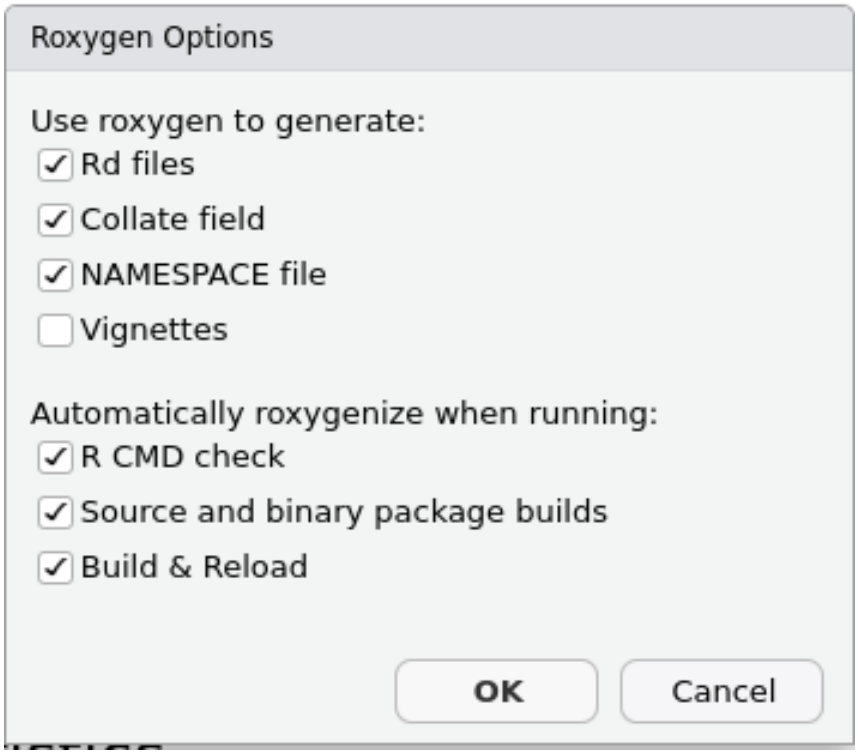


Figure 2:

- Configure to run automatically



2. Adding R code

- Put your R code files in /R
- Must be functions
- one function per file
- Add the roxygen skeleton to your code for each file
- **Code|Insert Roxygen Skeleton**
- Fill in skeleton

Example

```
#' Title
#'
#' @param par1
#'
```

```r
#' @return
#' @export
#'
#' @examples
testFunction <- function(par1 = "Hello" ) {
  cat(par1, "\n")
  }
```

3. Building package

- Use command **Build | Clean and Rebuild**
- Expect to get error messages!
- Fix until package builds
- If the package builds, it will be added to your list of packages

4. Checking the package

- Just because a package can build, doesn't mean that it is good!
- Use command **Build|Check**
- does a detailed check of entire package
- tries to run your examples
- *very* picky
- you will get many, many errors and warnings

Writing better code

- Turn on Code Diagnostics using **Tools|Global Options**

5. Creating the package file

- 2 options:
- **Build | Build Source Package** - contains source code (all languages)
- **Build | Build Binary Package** - contains compiled Fortran, C, C++ code
- Reason is that Windows computers usually don't have compilers
- If just using **R** code, make it a source package
- If you are using Fortran, C, C++, create both types

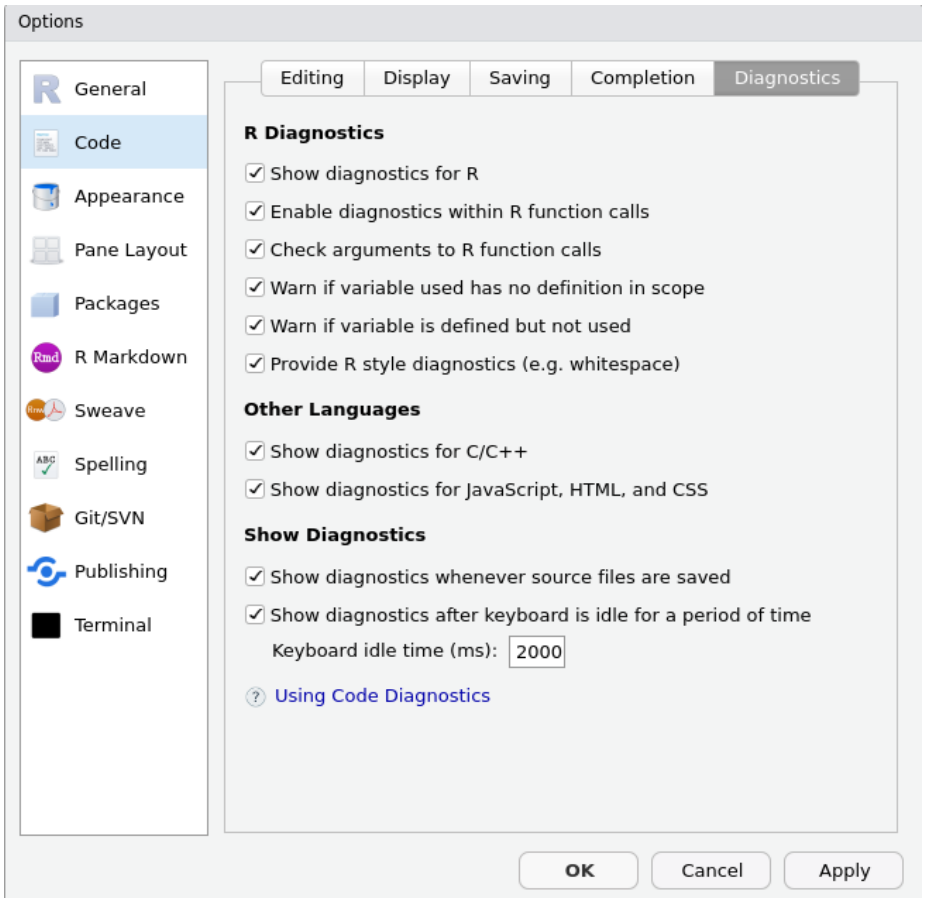

Options
General
Code
Appearance
Pane Layout
Packages
R Markdown
Sweave
Spelling
Git/SVN
Publishing
Terminal
Editing
Display
Saving
Completion
Diagnostics
R Diagnostics
Show diagnostics for R
Enable diagnostics within R function calls
Check arguments to R function calls
Warn if variable used has no definition in scope
Warn if variable is defined but not used
Provide R style diagnostics (e.g. whitespace)
Other Languages
Show diagnostics for C/C++
Show diagnostics for JavaScript, HTML, and CSS
Show Diagnostics
Show diagnostics whenever source files are saved
Show diagnostics after keyboard is idle for a period of time
Keyboard idle time (ms): 2000
Using Code Diagnostics
OK
Cancel
Apply

Figure 3:

Building the manual .pdf

- When the package is built, should also create the .pdf
- Must have LaTex installed
- For some reason, this doesn't work for me
- have to do it manually
- type in this command in the **R** console:

```
system("R CMD Rd2pdf mypackage")
```

Copying an existing repository

- You can create a package by cloning an existing git repository
- **File|New Project** and select **Version Control**
- Works with GitHub - just enter the url
- Try this one: https://github.com/CentreForHydrology/WISKIr

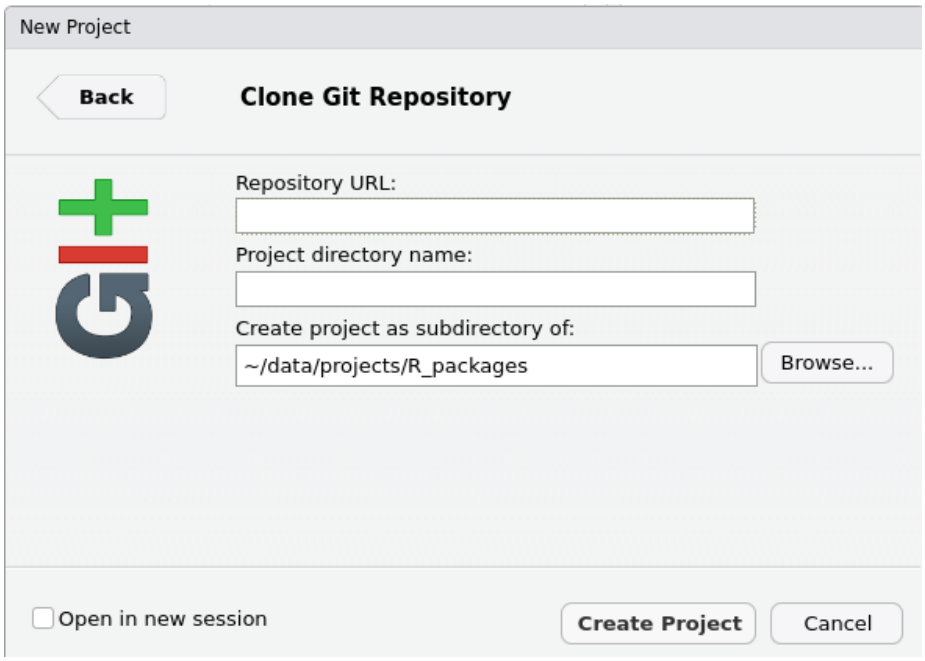


Figure 4:

Using git

- Every time you change your code, commit the changes to your git repository
- If you make a mistake, you can go back to an older version

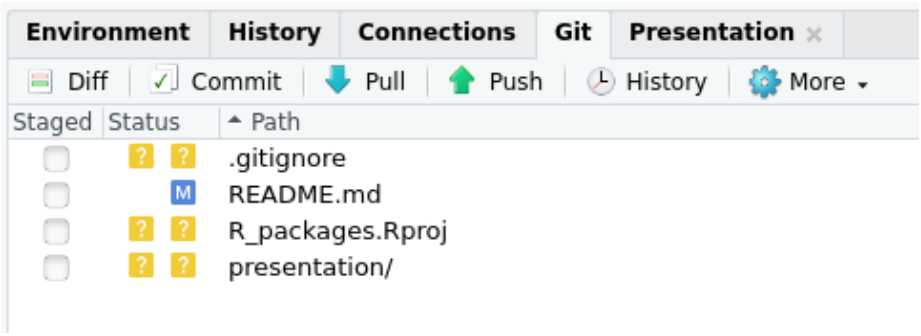


Figure 5:

Misc.

- Make sure you specify a licence for your code
  https://choosealicense.com/
- Don't forget to update the version number in DESCRIPTION
- version $< 1.0.0$ – not ready for outside use
- use major.minor.patch numbers
  https://semver.org/
- Remember to update the date in DESCRIPTION