Introduction to testing R code

https://stirlingcodingclub.github.io/code_testing

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- Code that initially works might not later under different conditions
- Encourages better coding (writing shorter, more manageable functions)
- Reassuring to double-check that *everything* works after changing something
- Gratifying to watch code pass multiple automated tests (it looks cool).

Testing all of your code at once is satisfying

```
==> devtools::test()

Loading GMSE
Testing GMSE
✔ | OK F W S | Context
✔ | 65       | gmse_apply tests [2.6 s]
✔ |  2       | Agent initialisation
✔ |  2       | Cost array initialisation
  |  0       | Main gmse function[1] "Initialising simulations ...  "
  |  1       | Main gmse function[1] "Initialising simulations ... "
  |  2       | Main gmse function[1] "Initialising simulations ... "
  |  3       | Main gmse function[1] "Initialising simulations ...  "
  |  4       | Main gmse function[1] "Initialising simulations ...  "
  |  6       | Main gmse function[1] "Initialising simulations ...  "
  |  7       | Main gmse function[1] "Initialising simulations ...  "
  |  8       | Main gmse function[1] "Initialising simulations ...  "
  |  9       | Main gmse function[1] "Initialising simulations ...  "
✔ | 11       | Main gmse function [4.5 s]
✔ |  2       | Interaction array and table initialisation
✔ |  4       | Landscape initialisation
✔ |  7       | Resource initialisation
✔ |  4       | Action array initialisation
✔ | 11       | Manager model
✔ |  8       | Observation model
✔ |  6       | Resource model
  |  0       | Summary functions[1] "Initialising simulations ...  "
  |  1       | Summary functions[1] "Initialising simulations ... "
  |  2       | Summary functions[1] "Initialising simulations ...  "
  |  3       | Summary functions[1] "Initialising simulations ...  "
  |  4       | Summary functions[1] "Initialising simulations ...  "
  |  5       | Summary functions[1] "Initialising simulations ...  "
✔ |  6       | Summary functions [3.0 s]
✔ | 11       | User model
✔ |  4       | Action and cost layer initialisation

══ Results ═══════════════════════════════════════════════════════════
Duration: 10.3 s

OK:       143
Failed:   0
Warnings: 0
Skipped:  0
```

Getting started: install the testthat package

Can install testthat from CRAN.

```
install.packages("testthat")
```

Or install from GitHub with the devtools R package.

```
devtools::install_github("r-lib/testthat");
```

Load testthat into Rstudio just like any other R package.

```
library(testthat);
```

Two simple functions to be tested

Consider one R script (file with .R extension) with functions.

Function 1: converts a temperature from Fahrenheit to Celsius.

```
F_to_C <- function(F_temp){
    C_temp <- (F_temp - 32) * 5/9;
    return(C_temp);
}
```

Two simple functions to be tested

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Function 1: converts a temperature from Fahrenheit to Celsius.

```
F_to_C <- function(F_temp){
    C_temp <- (F_temp - 32) * 5/9;
    return(C_temp);
}
```

Function 2: converts from Celsius to Fahrenheit.

```
C_to_F <- function(C_temp){
    F_temp <- (C_temp * 9/5) + 32;
    return(F_temp);
}
```

Two simple functions to be tested

Consider one R script (file with .R extension) with functions.

Function 1: converts a temperature from Fahrenheit to Celsius.

```
F_to_C(50)
```

```
## [1] 10
```

Two simple functions to be tested

Consider one R script (file with .R extension) with functions.

Function 1: converts a temperature from Fahrenheit to Celsius.

```
F_to_C(50)
```

```
## [1] 10
```

Function 2: converts from Celsius to Fahrenheit.

```
C_to_F(10)
```

```
## [1] 50
```

How the test_that function works

Example of a testthat R script, < test-temp_conversion.R >

```
library(testthat);
context("Temperature function testing");
source("temp_conversion.R"); # Functions to test

test_that("Fahrenheit to Celsius", {

  temp_C <- F_to_C(50);

  # Test that the result is numeric
  expect_that( is.numeric(temp_C), equals(TRUE) );

  # Test that the result is the correct value
  expect_that( temp_C, equals(10) );
})
```

How to run many tests quickly

Check Rstudio is set to the same directory as the test R script(s)

```
test_dir("."); # Runs all of your tests
```

The above will run all files with the prefix `test-` and extension `.R`.

How to run many tests quickly

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Test output looks like this:

```
✔ | OK F W S | Context
✖ |  4 1     | Temperature function testing |  4       | Temperature function testing
──────────────────────────────────────────────────────────────────────────────────────────
test-temp_conversion.R:30: failure: Fahrenheit to Celsius wrong
`x` not equal to `expected`.
1/1 mismatches
[1] 10 - 2 == 8
──────────────────────────────────────────────────────────────────────────────────────────

══ Results ═══════════════════════════════════════════════════════════════════════════════
OK:       4
Failed:   1
Warnings: 0
Skipped:  0
```

Testing as part of your coding work flow

Hadley Wickham also makes several key points about testing

- Helps spot bugs in the code earlier and see what needs fixing
- Multiple unit tests encourages smaller, manageable functions
- Writing failing tests can be useful when fixing bugs

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Additional resources

- Example of unit testing R code with testthat (John D. Cook)
- Testing R packages (Hadley Wickam)