tests/

January 2017

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Motivation

Your turn

You already know how to debug. Recall four helpful functions/features.

Four useful debugging tools

```
# Where is the problem?
traceback()

# Give me an interactive prompt here
browser()

# Give me an interactive prompt on error
options(error = recover)

# Convert warnings to errors
options(warn = 2)
```

Your turn

Why should you write tests?

Why do we test?

Correctness

Ensure current correctness

Interactive feedback

Reduce maintenance burden

Design

Think adversarially

Enable refactoring

Force good design

Working with others

Guard against future developers

Communicate with colleagues

Guard against complex interactions

Social pressure

Establish interfaces

http://matthewrocklin.com/blog/work/2016/02/08/tests

Other benefits

Code that can be tested easily, often has a better, more modular, design

When you stop working, leave a test failing. You'll know what to work on when you come back

Make big changes without fear of accidentally breaking anything

testthat

Provides easy transition from informal to formal tests. Can be used in wide variety of situations.

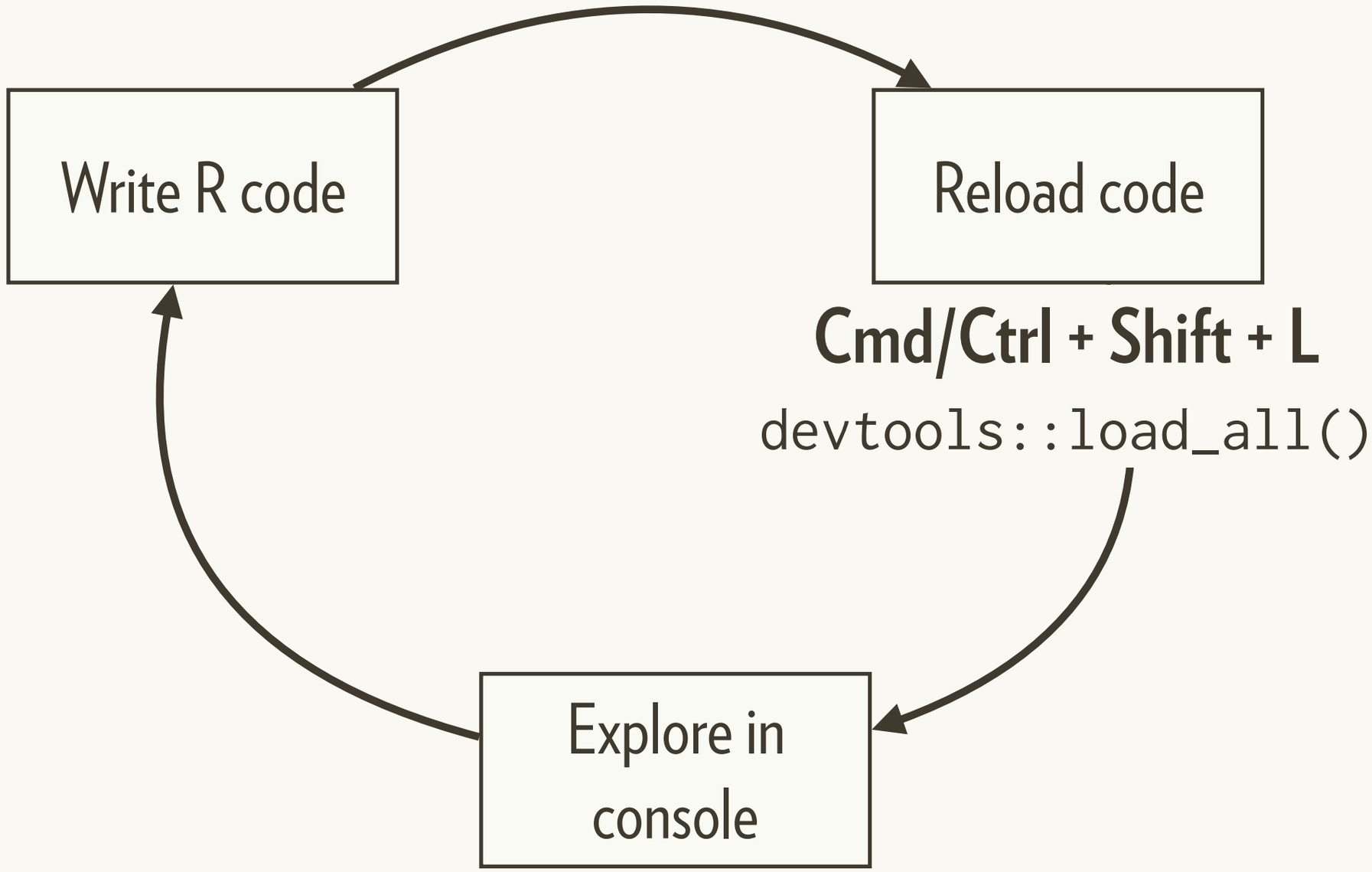
Wide range of expectations/assertions.

Fun output designed to keep you motivated.

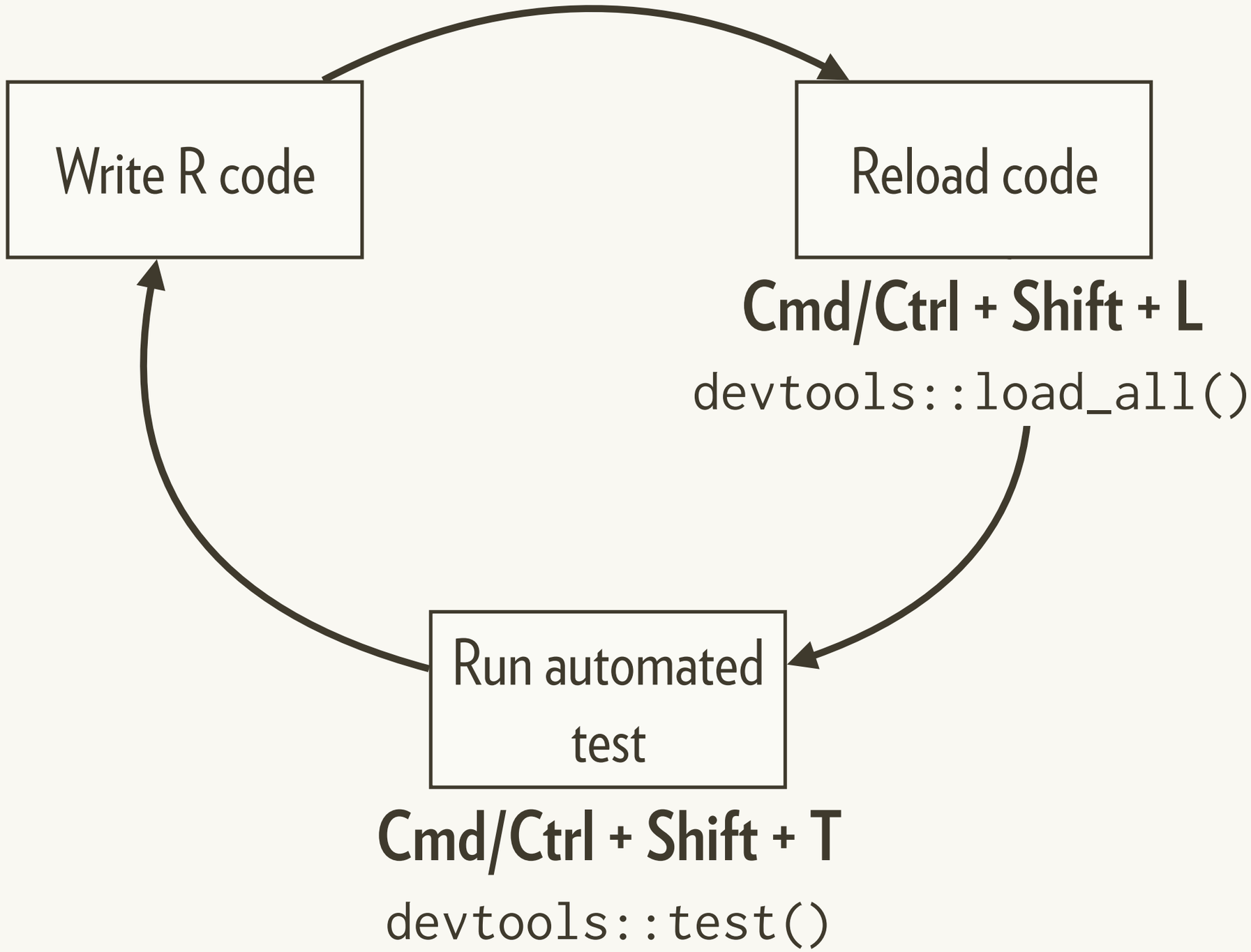
Currently used by over 1613 packages. Look at `tidyr`, `devtools`, `roxygen2`, `ffbase`, `ISOweek` for good examples.

`http://r-pkgs.had.co.nz/tests.html`

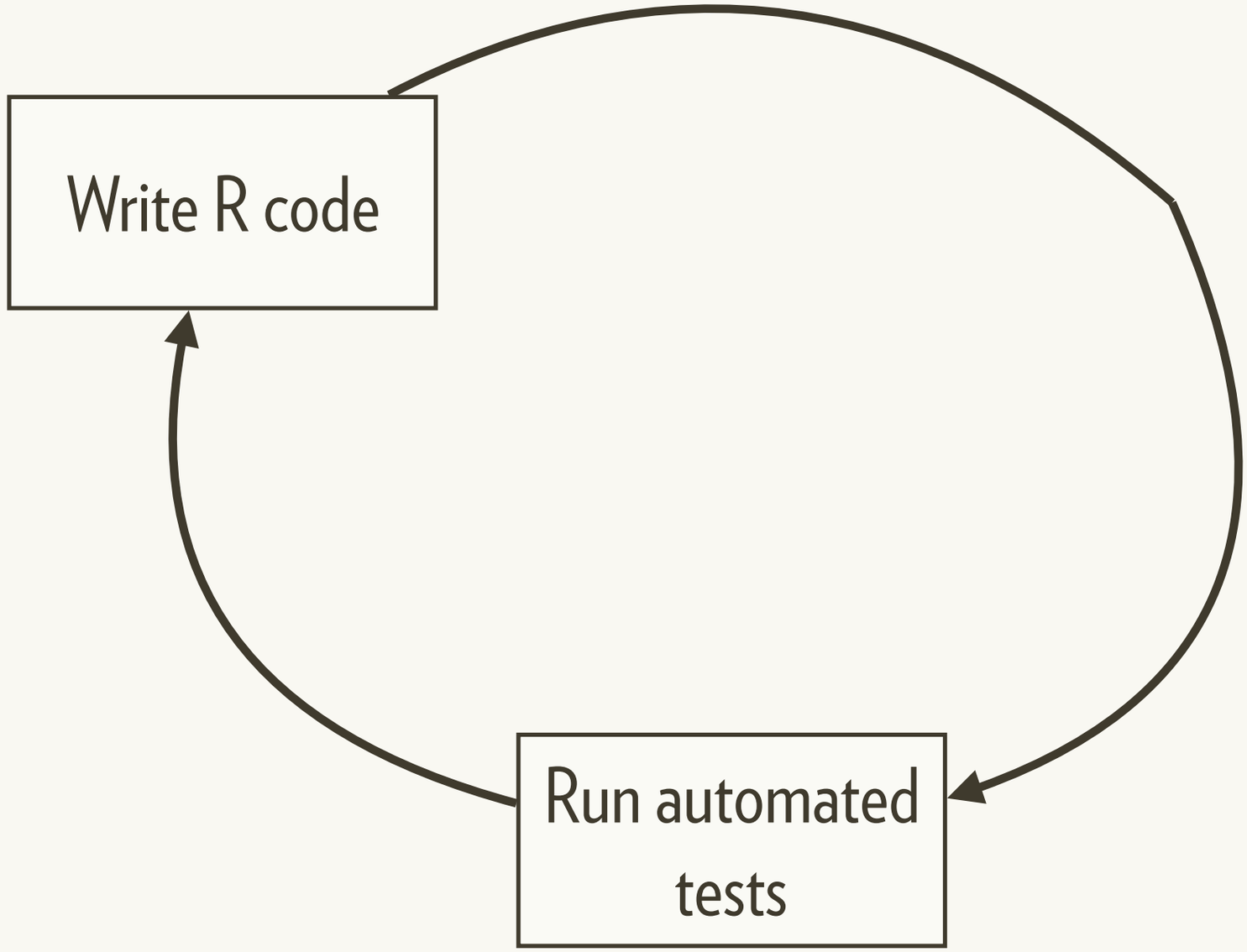
Workflow so far



Workflow so far



But why load the code?



Cmd/Ctrl + Shift + T

`devtools::test()`

Change working directory/project to:

[test-me]

Your turn

Where are the tests? Which tests are failing? Which function is probably the cause? Can you fix it?

Don’t skip me until you’ve tried to fix the test!

```
# Tests located in tests/testhat
# All failing tests in tests/testhat/test-variance.R
# So variance function probably to blame
VAR <- function(x) E((x - E(x) ^ 2))

# Should be
VAR <- function(x) E((x - E(x)) ^ 2)
```

Organisation

File

Test

Expectation

Expectation

Expectation

Expectation

Test

Expectation

Expectation

Expectation

Test

Expectation

Expectation

Expectation

Expectation

Test

Expectation

Expectation

Expectation

Expectation

```
# Expectations can test many things. Two common expectations
# are expect_equal and expect_error

test_that("probabilities must be positive and add to 1", {
  expect_error(rv(1, 0.9), "sum to 1")
  expect_error(rv(1, -0.1), "positive")
})

test_that("duplicate values have probabilities collapsed", {
  expect_equal(rv(c(1, 1)), rv(1))
  expect_equal(rv(c(1, 1, 2), c(0.25, 0.25, 0.5)), rv(1:2))
})
```

Your turn

Add the expectations on the following slide. What file should they go in? Modify the code to make the tests pass.

```
test_that("expectation throws error if input not an rv", {
  expect_error(E("a"), "must be an rv object")
})

test_that("expectation of a number is that number", {
  expect_equal(E(5), 5)
})
```

```
test_that("variance of a constant is 0", {
  expect_equal(VAR(10), 0)
})

test_that("variance throws error if input not an rv", {
  expect_error(VAR("a"), "must be an rv object")
})
```

Abbreviation	Test
`expect_equal`	Uses `all.equal()`, ignores floating point differences
`expect_identical`	Uses `identical()` for stricter numerical testing.
`expect_equivalent`	Like `expect_equal()`, but also ignores differences in attributes.
`expect_s3_class` `expect_s4_class`	Check that inherits from a given class.
`expect_true` / `expect_false`	Catch all expectations for anything not otherwise covered

Abbreviation	Test
`expect_matches`	Does any value match the supplied regular expression?
`expect_output`	Does printed output match the supplied regular expression?
`expect_message`	Does displayed messages match the supplied regular expression?
`expect_warning`	Do any warnings match supplied regular expression?
`expect_error`	Do any errors match supplied regular expression?

How to create tests?

1. Compare with known outputs.
2. Compare with results calculated another way.
3. Whenever you find a bug, first figure out the right answer and write a test.
4. Test areas that are likely to fail (i.e. complicated bits).
5. Focus on improving tests over time, not being perfect when you first start.
6. (Exciting work going on at https://github.com/jimhester/covr)

Your turn

How might you test the probability function?
Brainstorm with 2 minutes with your neighbours.

Your turn

Create a new file (and new context) for testing P(). Do you discover any new bugs?

Read ?devtools::use_test()

```
context("Probability")

test_that("0 probability of being infinite", {
  X <- rv(1:10)
  expect_equal(P(X > -Inf), 1)
  expect_equal(P(X < -Inf), 0)
  expect_equal(P(X > Inf), 0)
  expect_equal(P(X < Inf), 1)
})

test_that("missing comparison means 100% of NA", {
  X <- rv(1:5)
  expect_equal(P(X > NA), NA_real_)
  expect_true(is.na(P(X > NA)))
}
```

Other challenges

How could you test that (e.g) `dice + dice` gives the correct result? How would you test that lm() gives the correct result?

How would you test `rsim()`?

How would you test `plot.rv()`?

How would you test connecting to a website?

Other challenges

How could you test that (e.g) `dice + dice` gives the correct result? How would you test that lm() gives the correct result? (expect_equal_to_reference)

How would you test `rsim()`?
(use pure functions as much possible)

How would you test `plot.rv()`?
(see vdiffr)

How would you test connecting to a website?
(try_again)

Putting it all together

Challenge: make this into a package

```
col_summary <- function(df, fun) {
  stopifnot(is.data.frame(df))

  df_num <- purrr::keep(df, purrr::is_numeric)
  as.data.frame(purrr::map(df, fun))
}
```

Your turn

Back at 2:25pm

1. Brainstorm a name for this package.
2. Create a new package.
3. Update DESCRIPTION
4. Add col_summary() & verify it works.
5. Add purrr as a dependency.
6. Document col_summary().
7. Convert your informal tests to formal tests.

Remember these functions:

Back at 1530

```
devtools::create()

devtools::use_package()
devtools::use_testthat()
devtools::use_test()

# Some common problems are listed on the next slide
```

Problem: Accidentally pressed source

Symptoms: load_all() stops working

Diagnosis: Check your environment pane

Cure: Restart R