Advanced Data Analysis in R

Advanced `rmarkdown`

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Why is `rmarkdown` important?

It's all about communication and documentation!

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2. Our reports change change with our data

- Tying our analysis to our output documentation

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- No more of this https://youtu.be/s3JldKoA0zw

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- Can be created from within the R Studio Integrated Development Environment (IDE)

Some technical details. . .

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Some technical details...

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  - LaTeXfor pdf style outputs (and beamer)
  - html
  - html + javascript
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  - ...
- Specific commands can be issued depending on the output used (LaTeXand/or html tags)

Building Your Documents

Three Components to an Rmarkdown Documents

1. yml header than contains metadata and build instructions

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2. Markdown mark-up conventions

3. Code chunks with language and output instructions

Yet Another Markup Language

Parts of An R Markdown Documents

yml header instructs to pandoc engine how to build the documents

```
---
title:
subtitle:
author:
abstract:
date:
output:
---
```

You can access R code from within the yml

Utilising back ticks and the letter "r" you can include R code into your 'yml'

```
---
title: "This is a quick example"
subtitle: "Just to illustrate a point"
author: "William Gosset"
date: "2018-01-23 Updated(2019-02-12)"
abstract: "Just a little exloration of things. We looked at `nro
bibliography: my_bib.bib
output:
  pdf_document
---
```

A Little More About Outputs. . .

Rmarkdown Outputs

- pdf_document

Presentations

My Preferred

_____

A Little More About Outputs. . .

Rmarkdown Outputs
- pdf_document
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A Little More About Outputs...

Rmarkdown Outputs
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Presentations
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My Preferred
- bookdown::pdf_document2[1]

---

[1]Almost identical to pdf_output but provides additional control over code chuck references. Requires the bookdown package

Markdown

Rmarkdown = R + Markdown

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- Keyboard symbols to generate basic `html` outputs

- Additionally allows you to interleave plain text with code

Markdown Examples

italics or *italics*

__bold__ or **bold**

sub~script~

super^script^

⤳

Markdown Examples

italics or *italics*

bold or **bold**

sub$_{script}$

super^{script}

Markdown Examples

R Studio hosts a ton of great example Rmarkdown reports here

Code Chunk

Using Code Chunks

Rmarkdown documents are powerful because of code chunks

They can be inserted into a document by `CMD/CTRL + OPTION + I`

Best practice is to name each chunk to help with debugging

Writing R Code

Write code just like you would with any R scripts:

- call libraries

```
rnorm(1, 10, 1)
## [1] 11.90716
```

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```

Writing R Code

Write code just like you would with any R scripts:

- call libraries
- write code
- any code is executed and printed as in the console

```r
rnorm(1, 10, 1)
## [1] 11.90716
```

Compiling the Documents

A document will not compile if a chunk has an error!

Use Chunk Options to Control the Outputs

Some times you don't want everything printed when you compile (knit) the document

Different messages that can be set for each code chunk:

- Echo - If `false` then no code is printed

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- Warnings - If false no warning messages are printed

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- `Messages` - If `false` no messages are printed

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Different messages that can be set for each code chunk:

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- Warnings - If false no warning messages are printed
- Messages - If false no messages are printed
- Include - If false no echo, no warnings, no messages printed

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- `Messages` - If `false` no messages are printed
- `Include` - If `false` no echo, no warnings, no messages printed
- `Eval` - If `false` the chunk won't be evaluated

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Different messages that can be set for each code chunk:

- `Echo` - If `false` then no code is printed
- `Warnings` - If `false` no warning messages are printed
- `Messages` - If `false` no messages are printed
- `Include` - If `false` no echo, no warnings, no messages printed
- `Eval` - If `false` the chunk won't be evaluated
- `Error` - If `true` allows chunk to display an error

Use Chunk Global Options

Chunk options can be set locally or globally

Global options are over-written by local options

Accessing global options

```r
knitr::opts_chunk$set(echo = FALSE,
                      warning = FALSE,
                      message = FALSE)
```

Accessing *Other* Languages

```r
names(knitr::knit_engines$get())
## [1] "awk"       "bash"      "coffee"    "gawk"
## [5] "groovy"    "haskell"   "lein"      "mysql"
## [9] "node"      "octave"    "perl"      "psql"
## [13] "Rscript"   "ruby"      "sas"       "scala"
## [17] "sed"       "sh"        "stata"     "zsh"
## [21] "highlight" "Rcpp"      "tikz"      "dot"
## [25] "c"         "fortran"   "fortran95" "asy"
## [29] "cat"       "asis"      "stan"      "block"
## [33] "block2"    "js"        "css"       "sql"
## [37] "go"        "python"    "julia"
```

Setting Engine

Generally you will need specify where the executable file is to run other languages

```
knitr::opts_chunk$set(engine.path = list(
  python = '~/anaconda/bin/python',
  ruby = '/usr/local/bin/ruby'
))
```

A Motivating Example

Write my code is Stan specifying `output.var = "stan_example"` in the chunk options

```
parameters {
  real y[2];
}
model {
  y[1] ~ normal(0, 1);
  y[2] ~ double_exponential(0, 2);
}
```

Fit the Model

```
library(rstan)
fit <- sampling(stan_example, cores = 2,
                iter = 50, refresh = 0)
```

Print the Results Directly

```
print(fit)
## Inference for Stan model: 6c400a2ac89dae0e85da9f767
## 4 chains, each with iter=50; warmup=25; thin=1;
## post-warmup draws per chain=25, total post-warmup
##
##       mean se_mean   sd  2.5%   25%   50%   75% 97
## y[1] -0.02    0.14 1.07 -2.39 -0.76  0.09  0.62  2
## y[2]  0.15    0.83 3.80 -7.59 -1.10  0.48  2.44  7
## lp__ -1.99    0.67 1.60 -5.37 -2.92 -1.47 -0.71 -0
##       n_eff Rhat
## y[1]     61 1.00
## y[2]     21 1.12
## lp__      6 1.45
##
```

Controlling Output

Chunk options can also be used to specify

- output size of figure via fig.out, fig.width, fig.height

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- output size of figure via fig.out, fig.width, fig.height

- captions with fig.caption

Automating Rmarkdowns

An additional `yaml` argument can be passed call `params`

```
---
params:
  team: "Wake Forest"
  sport: "Football"
---
```

Using the Parameters

The parameters can be be used in other code chunks

```
data %>%
filter(team = params$team, sport = params:sport)
```

And now the code will function for any available team/ sport
you specify.

A Report for Each Team and Sport!

Further, if you desired a standard report for different combinations of team

```
params_start <- list(team= "Wake Forest",
            sport= "Football)

output <- gsub(pattern = " ", "_", unique(params_start$team))

output <- paste0("outputs/", Sys.Date(),"_",output,".pdf")

params <-lapply(dept_key$department, FUN = function(x){c(
  params_start, list(team = x))})

reports <- tibble(output_file = output, params)
```

Now Knitr the Series of Reports

```
library(rmarkdown)

pwalk(.l = reports,
      .f = render, input = "my_template_report.Rmd")
```

Making Basic Tables

The basic way to make a table in R is through the kable function from knitr

```
knitr::kable(head(mtcars,4)[,1:3])
```

	mpg	cyl	disp
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
Hornet 4 Drive	21.4	6	258

Additional Table Options

The basic way to make a table in R is through the kable function from knitr

```
knitr::kable(head(mtcars,4)[,1:3],
             caption = "A Basic Table",
             col.names = c("One", "Two", "Three"))
```

Table 2: A Basic Table

	One	Two	Three
Mazda RX4	21.0	6	160
Mazda RX4 Wag	21.0	6	160
Datsun 710	22.8	4	108
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Extending RMarkdown

LaTex

- You can use LaTex extensively

```
---
includes:
  in_header: my_format.tex
---
```

LaTex

- You can use LaTex extensively

- This include LaTex templates and cls for control

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  in_header: my_format.tex
---
```

LaTex

- You can use LaTex extensively

- This include LaTex templates and cls for control

- Different citation styles

```
---
includes:
  in_header: my_format.tex
---
```

Advanced Packages

Table/ Figure Generation
- `kableExtra`

Templates

Even More

Advanced Packages

Table/ Figure Generation

- kableExtra
- gt

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Even More

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Table/ Figure Generation

- kableExtra
- gt

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- rticles

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Table/ Figure Generation

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Templates

- rticles
- papaja
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Even More

- flexdashboard
- shinydashboard

Other Resources

Rmarkdown
R Studio Cheat Sheets for the basic commands Introduction to Rmarkdown for the basic ideas and getting started R Markdown Definitive Guide for the details for how Rmarkdown works

Bookdown
For Writing Books

Blogdown
For writing blogs/ websites

Scripts vs Rmds

Everything in an Rmd File?!

Always

- Final reports/ analysis

Except

But...

knitr::purl can make an Rmd into an R file

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Everything in an Rmd File?!

Always
- Final reports/ analysis
- Exploratory work

Except
- Code outnumbers Prose -> scripts
- Can run large scripts from within an Rmd with `source`

But...
`knitr::purl` can make an Rmd into an R file

Summary

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2. Whatever format you want can be done (but it might be a challenge)
3. You can work in *multiple* languages!