Statistical Computing

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Statistical Computing: What will we do?

Chapters

1. R in Action
2. Statistical Inference
3. Linear Models
4. Model Selection and Validation
5. Trees
6. Neural Nets

Remarks

- Chapters 3 to 6:
  Statistical ML in Action
- Two weeks per chapter
- Exercises at end of chapter notes

R in Action

Outline

Refresh R skills

Data Analysis

- Base R
- The pipe
- dplyr
- ggplot2
- R Markdown

Writing Functions

- Why functions?
- Code style
- Organization
- dplyr and ggplot2
- plot, print, summary

Data Analysis

- Throughout the lecture, we will work with R
- Today, focus is on data preparation and descriptive analysis
- Essential part of every analysis
- Base R has hundreds of functions to help you here

Example

Contributed extension packages help as well. Let's look at some of them ...

The Pipe Operator avoids Function Chains

- In “magrittr” package
- On CRAN since 2014 (Stefan Milton Bache)
- Turns `f(x, y)` into `x %>% f(y)`
- Since R 4.1, `"|>"` in base R
- Use short-cut `"Ctrl-shift-m"`

Example

Figure: `https://en.wikipedia.org/wiki/The_Treachery_of_Images`

"dplyr": Grammar of Data Manipulation

Core "verbs"

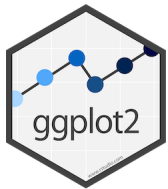
- `select()`
- `filter()`
- `arrange()`
- `mutate()`
- `summarize()`

Dream team with pipe

- Verbs take as first argument a dataframe and return modified dataframe
- On CRAN since 2014 (Hadley Wickham)
- Like "magrittr", part of tidyverse
- Translate between base R and dplyr?

Example

“ggplot2”: Grammar of Graphics



Modify plot layer per layer

- Simple “+” instead of %>%
- On CRAN since 2007 (Hadley Wickham)
- Also in tidyverse

“plotly” package

- Interactive figures
- Wraps JavaScript library
- Can translate ggplot to Plotly

Example

Reports with R Markdown

Markdown text + R code
→ HTML, Word, PDF
On CRAN since 2014 (Yihui Xie)

Example

- Markdown syntax
- Simple R Markdown file

Workflow

1. Create .Rmd with YAML header
2. Write analysis and adapt YAML
3. Hit "Knit"/`rmarkdown::render()`

When you hit "Knit"

1. `knitr::knit()` searchs code chunks, runs them and "knits" the results with your Markdown text to a temporary .md file
2. The .md file is converted to desired output with Pandoc, using YAML header to specify its call

Writing Functions

Already used many functions

- `mean()`
- `ggplot2::ggplot()`
- `+`

Write own functions to

- avoid code duplication
- produce readable code

Example

Code style

- Line length, curly braces, spaces?
- Comments: Why, not what
- Defensive programming: `if` + `stop()`

Example

Organizing functions

`source(functions.R)` or own package

Example

dplyr and ggplot2 in functions

Unquoted variable names look nice

- `diamonds %>% select(price, color)`
- `ggplot(diamonds, aes(x = color))`
- `facet_grid(~ color)`

But what if “price” and/or “color” should be passed as function arguments?

Some solutions

- `select(all_of(c("price", "color")))` → `select(price, color)`
- `aes(x = .data[["color"]])` → `aes(x = color)`
- `reformulate("color")` → `~ color`

Example

plot, print, summary

Generic functions

- plot, print, summary, predict, ...
- Depend on class of object

Example

S3 System

- Simple object oriented system
- Generic function calls `UseMethod()` to find class method, e.g. `plot()` → `UseMethod()` → `plot.factor()`
- Write new class method of existing generic function
- Or write new generic

Example