Overview

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Why R?

- Free of charge (though paid support options are available).
- Open source and extensible.
- Over 10,000 available libraries for all kinds of specialized tasks.
- Very popular *programming language* for statistics. "It promotes experimentation and exploration, which improves data analysis."
- Great for visualization. Excellent packages for graphics.
- A very active and helpful community.
- Very flexible: Good support for metaprogramming, first class functions, first-class environments.
- Supports array-based programming.

What is R anyway?

If you are coming from SAS or Stata, you are better off thinking about it as a programming language and not as a statistical environment:

- Interpreted: Slower execution than compiled languages but potentially faster development time (immediate feedback, no compilation step).
- Dynamically typed: Data types are associated with values, not variables. Type checking occurs on as as-needed basis at runtime. Harder to identify bugs but makes metaprogramming easier, less "language bureaucracy."
- Multi-paradigm: Supports different styles of programming: functional, imperative, object-oriented, array, procedural, reflective.
- Interactive or batched: May run scripts and/or enter commands through a command prompt (REPL). Interactive programming useful for experimentation and debugging.

The extension of the R files is usually `.R`. This is merely a common convention (R doesn't care what extension is used).

SAS vs. R

Some advantages of SAS:

- Centralized support.
- Easier to work with data sets that do not fit in main memory. R requires special packages for this; these packages are not well-integrated with the rest of R.
- Quality of documentation is more consistent.
- More consistent naming conventions.
- Better integration with SQL.
- Better default logging behavior.

Some advantages of R:

- Free.
- Open source. You may inspect and modify anything you wish.
- More available methods (10,000+ packages).
- New methods are almost always released in R first. If you want the cutting edge, use R.
- Superior graphing libraries.
- Matrix operations supported by both languages but better integrated in R.
- Resembles other languages (e.g., Python, Matlab)... easier to transfer skills.
- More flexible/extensible. Writing highly customized code is easy & intuitive.
- Faster market growth. Academia shifting to R.
- The only common tongue between statisticians & data scientists.

Other differences:

- SAS is split into many sub-languages: DATA step, PROCs, macros, IML, SCL, etc. R is more uniform: processing of all kinds is handled by function (procedure) application.
- SAS: Individual procedures often heavyweight, covering many uses. R: Procedures (called "functions" in R lingo) are often more specialized.
- SAS: Generally verbose output. R: Generally terse output. If you want something, you have to ask for it.
- R is more free-form, resembling more traditional programming languages.

RStudio

R can be downloaded from the Comprehensive R Archive Network, CRAN. We will be using RStudio, a popular IDE. It is important to keep in mind that R (the language) and RStudio (the GUI) are separate things, and it is entirely possible to use different workflows with other tools or text editors:

- `emacs` through ESS.
- `vim` with the Vim-R-Plugin.
- Sublime Text.
- Scite.
- Notepad++.

A few useful resources

There is a constantly growing collection of materials available offline and online to learn R. The Journal of Statistical Software and the Use R! series from Springer regularly publish applications of R to different domains.

A good overview for beginners is Learning R.

SAS users may find useful R for SAS and SPSS users, although I have never used it myself.

For the analysis of compley survey data, you may want to take a look to "Complex Surveys. A Guide to Analysis Using R".

The official documentation in CRAN (The Comprehensive R Archive Network) is available to read but goes well beyond the scope of this class.

Looking around

RStudio offers four basic windows.

- Console (R interpreter)
- Code, where we will write our code.
- History/Environment
- Plots/Packages/Help

Getting help

Documentation in R can be accessed through the interpreter. For instance, if we wanted to get information about what `lm` does, or what paramaters it takes or some examples of usage, we would type:

```
?lm
```

To search for a topic, one can type:

```
??"nonlinear regression"
help.search("nonlinear regression") # alternative syntax
```

Note that the above only searches through installed packages. Better search method: Google. ;)

The R community is very helpful and active. If you ever get stuck in a problem, the best solution is to ask in StackOverflow, a very large community of programmers using the `#r` tag.

Like other single-letter languages, R can be tricky to Google. Try: "R programming," "R statistics."

Within Westat, there is a growing community of users and we have a number of resources for Q&A and sharing information or announcements.

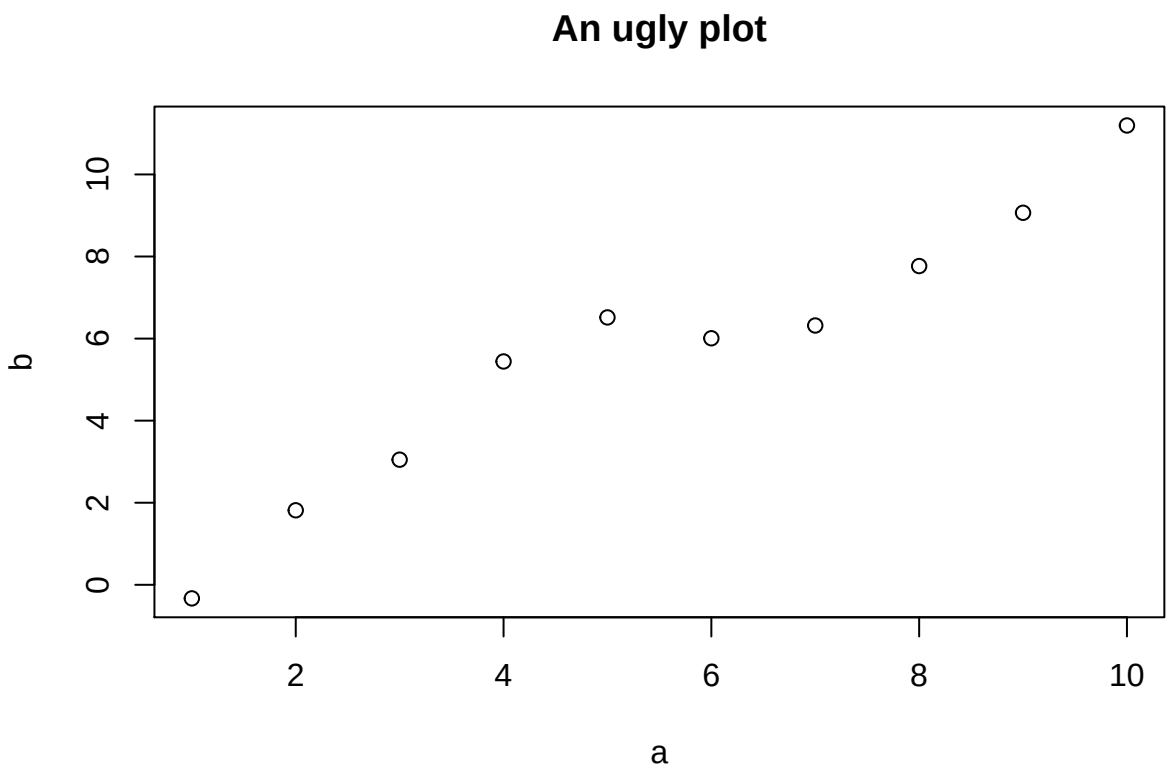
About this document

We (Gonzalo & I. . . mostly Gonzalo) have prepared these materials using using Rmarkdown, a format that makes it easy to create dynamic documents. The text is written in markdown, an easy markup language ("easy-to-read, easy-to-write"): `_italic_`, `**bold**`, . . . but it also allows to include chunks of executable R code. It simplifies reproducibility and it is very easy to share.

For instance,

is rendered as:

```
N <- 10
a <- 1:N
b <- a + rnorm(N)
plot(a, b); title("An ugly plot")
```



These course notes are a slightly modified version of notes created by Westat data scientist, Gonzalo Rivero.