

# 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-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

- SAS: Licensed, closed source. R: Free, open source. New methods are almost always released in R first.
- SAS has centralized support; R does not.
- 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.
- R is more free form. More closely resembles other languages (e.g., Python, Matlab).
- Unlike SAS, R assumes data fit into main memory. Special packages required for larger data sets.
- SAS has better integration with SQL
- Most data scientists don’t use SAS. Most statisticians don’t use Python. R is a common tongue.
- Output in R is usually more terse. If you want something, you have to ask for it.

## 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 complex 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 parameters 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")
```

**An ugly plot**

