Introducción a los métodos estadísticos bayesianos en Ecología

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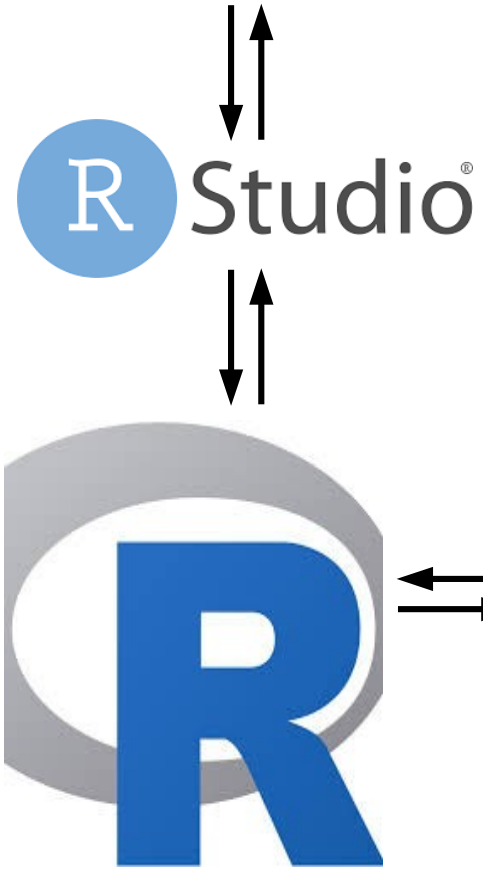
Durante el curso, uds trabajarán con RStudio que interactuará con R, y éste con otros programas a través de una serie de librerías.

El flujo de interacciones entre el Usuario y el software se puede resumir así:



Paquete de R que interactúa con:	Generador de MonteCarlo
R2WinBUGS	WinBUGS
R2Openbugs	OpenBugs
rjags,runjags,R2jags	JAGS
INLA	INLA
rstan, brms,rstanarm	STAN

Y hay otras opciones como NIMBLE, LaplaceDemon, etc...

Vamos por partes:

a) Instalación de R

b) Instalación de R-Studio

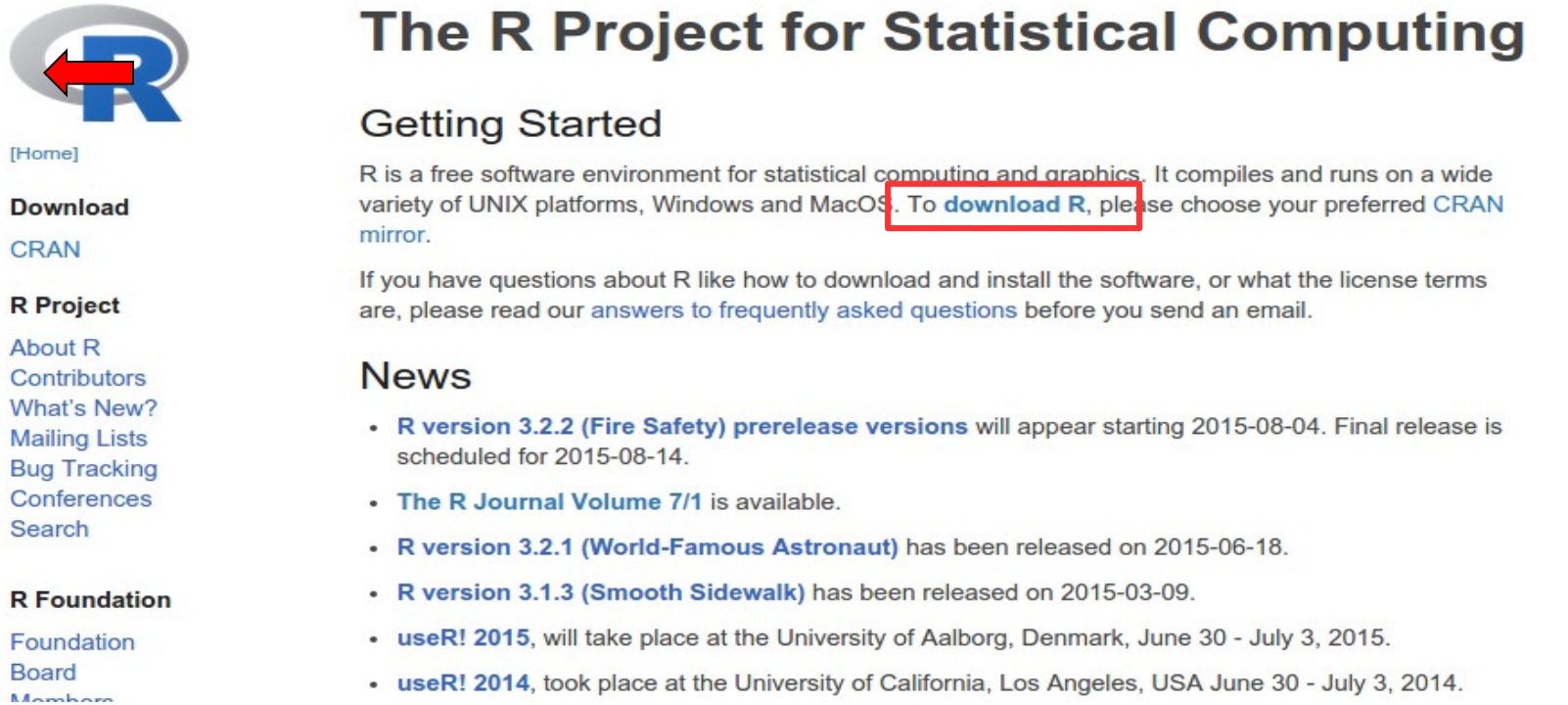
c) Instalación de JAGS, INLA y STAN

d) Instalación de librerías adicionales para el curso

a) Instrucciones para instalar R:

https://www.datacamp.com/tutorial/installing-R-windows-mac-ubuntu

a1) Ir al sitio: http://www.r-project.org/



Luego de seleccionar “CRAN”, aparecerá una pantalla donde se seleccione el sitio (repositorio) desde donde se obtendrá el archivo de instalación.

a2) La pantalla siguiente permite seleccionar el repositorio desde donde se va a instalar R:

CRAN Mirrors

The Comprehensive R Archive Network is available at the following URLs, please choose a location close to you. Some statistics on the status of the mirrors can be found here: main page, windows release, windows old release.

0-Cloud	
https://cran.rstudio.com/	Rstudio, automatic redirection to servers worldwide
http://cran.rstudio.com/	Rstudio, automatic redirection to servers worldwide
Algeria	
http://cran.usthb.dz/	University of Science and Technology Houari Boumediene
Argentina	
http://mirror.fcaglp.unlp.edu.ar/CRAN/	Universidad Nacional de La Plata

Seleccionar uno de estos sitios, por ej.

(todos los sitios tienen la última versión de R)

a3) Seleccionar el Sistema Operativo:

CRAN
Mirrors
What's new?
Task Views
Search

About R
R Homepage
The R Journal

Software
R Sources
R Binaries
Packages
Other

Documentation
Manuals
FAQs
Contributed

The Comprehensive R Archive Network

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- Download R for Linux
- Download R for (Mac) OS X
- Download R for Windows

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Source Code for all Platforms

Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- The latest release (2015-06-18, World-Famous Astronaut) R-3.2.1.tar.gz, read what's new in the latest version.
- Sources of R alpha and beta releases (daily snapshots, created only in time periods before a planned release).
- Daily snapshots of current patched and development versions are available here. Please read about new features and bug fixes before filing corresponding feature requests or bug reports.
- Source code of older versions of R is available here.
- Contributed extension packages

a4) Luego de seleccionar R para Windows:

CRAN
Mirrors
What's new?
Task Views
Search

About R
R Homepage
The R Journal

Software

R for Windows

Subdirectories:

base	Binaries for base distribution. This is what you want to **install R for the first time**.
contrib	Binaries of contributed CRAN packages (for R >= 2.13.x; managed by Uwe Ligges). There is also information on third party software available for CRAN Windows services and corresponding environment and make variables.
old contrib	Binaries of contributed CRAN packages for outdated versions of R (for R < 2.13.x; managed by Uwe Ligges).
Rtools	Tools to build R and R packages. This is what you want to build your own packages on Windows, or to build R itself.

Seleccionar

Please do not submit binaries to CRAN. Package developers might want to contact Uwe Ligges directly in case of questions / suggestions related to Windows binaries.

You may also want to read the R FAQ and R for Windows FAQ.

Note: CRAN does some checks on these binaries for viruses, but cannot give guarantees. Use the normal precautions with downloaded executables.

R-3.5.1 for Windows (32/64 bit)

CRAN
Mirrors
What's new?
Task Views
Search

About R
R Homepage
The R Journal

Software
R Sources
R Binaries
Packages
Other

Documentation
Manuals
FAQs
Contributed

Download R 3.5.1 for Windows (62 megabytes, 32/64 bit)
Installation and other instructions
New features in this version

Selecciona la última versión

If you want to double-check that the package you have downloaded matches the package distributed by CRAN, you can compare the md5sum of the .exe to the fingerprint on the master server. You will need a version of md5sum for windows: both graphical and command line versions are available.

Frequently asked questions

- Does R run under my version of Windows?
- How do I update packages in my previous version of R?
- Should I run 32-bit or 64-bit R?

Please see the R FAQ for general information about R and the R Windows FAQ

Las “opciones por defecto” de instalación también generalmente funcionan bien….

- Patches to this release are incorporated in the r-patched snapshot build.
- A build of the development version (which will eventually become the next major release of R) is available in the r-devel snapshot build.
- Previous releases

Note to webmasters: A stable link which will redirect to the current Windows binary release is <CRAN MIRROR>/bin/windows/base/release.htm.

a5) Hacer click sobre el archivo R.***.exe que instalará R creando un directorio R en “Archivos de programa”.

a6) El uso de R en Windows require tener RTOOLS.

Rtools contiene compiladores que son necesarios para compilar e instalar a partir del código fuente aquellos paquetes o librerías escritos en C/C++ o Fortran.

TENER Rtools INSTALADO ES PARTICULARMENTE CLAVE EN ESTE CURSO ya que usamos paquetes que hacen interfase con otros programas como Stan y Jags.

Ir a: https://cran.r-project.org/bin/windows/Rtools/

Seleccionar según la versión de R que tenga.

Se descarga un archivo ejecutable con extensión .exe, y sólo se hace click en el mismo para instalar Rtools.

a7)  Navegar a http://cran.r-project.org/bin/macosx/ y descargar el paquete que corresponda a nuestro sistema. *Não Sei!!!*

a8) Linux Lo más simple es instalar el archivo deb que bajen del repositorio con "Ubuntu Software Center".

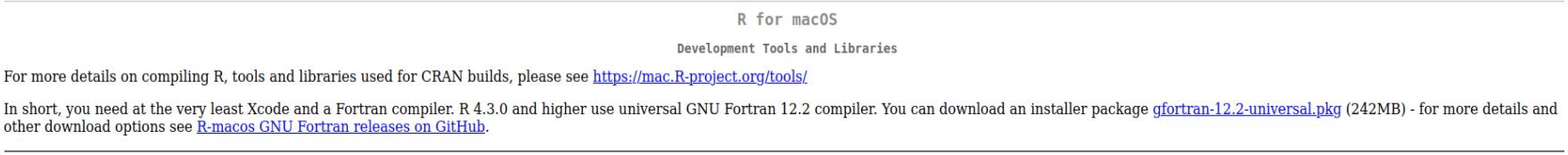
También puede hacerse desde el Terminal:

```
sudo add-apt-repository "deb
http://cran.rstudio.com/bin/linux/ubuntu $(lsb_release -cs)/"
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv-keys
E084DAB9
sudo apt-get update
sudo apt-get install r-base r-base-dev
```

En Mac podría ser necesario descargar un bundle equivalente a RTOOLS que solo existe para Windows.

NO TENGO CERTEZA DE ESTO.

Si fuese necesario, ir a https://cran.r-project.org/bin/macosx/tools/



R for macOS

Development Tools and Libraries

For more details on compiling R, tools and libraries used for CRAN builds, please see https://mac.R-project.org/tools/

In short, you need at the very least Xcode and a Fortran compiler. R 4.3.0 and higher use universal GNU Fortran 12.2 compiler. You can download an installer package gfortran-12.2-universal.pkg (242MB) - for more details and other download options see R-macos GNU Fortran releases on GitHub.

Y simplemente seguir las instrucciones habituales para descargar e instalar un archivo ejecutable.

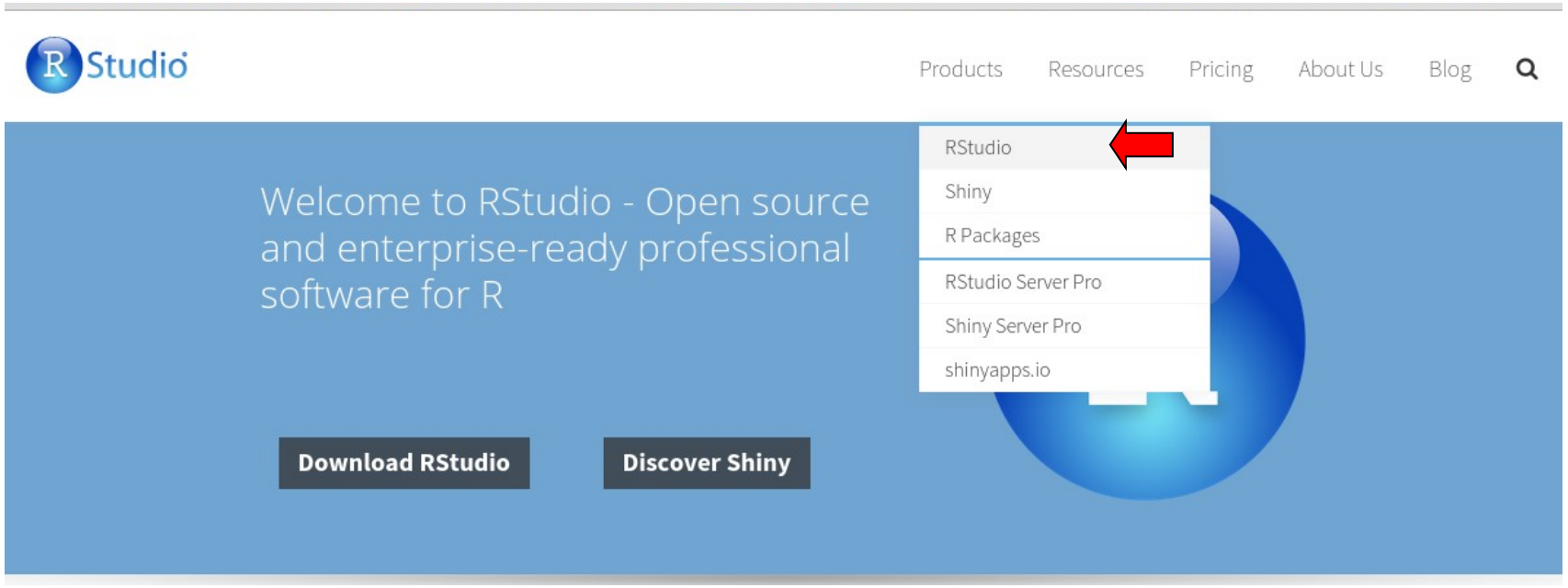
Para envidia de las víctimas de Windows y Mac, nada de lo anterior es necesario en Linux.

b) Instrucciones para instalar RStudio:

basado en líneas de comando (y no en el extenso uso del mouse).

Programas (gratuitos) como RStudio hacen esta interación mas amigable.

b1) Ir a: www.rstudio.org



RStudio b2)

Products Resources Pricing About Us Blog

RStudio

Home / Overview / RStudio

Take control of your R code

RStudio is an integrated development environment (IDE) for R. It includes a console, syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management. Click here to see more RStudio features.

RStudio is available in open source and commercial editions and runs on the desktop (Windows, Mac, and Linux) or in a browser connected to RStudio Server or RStudio Server Pro (Debian/Ubuntu, RedHat/CentOS, and SUSE Linux).

CLICK HERE TO SEE ADDITIONAL FEATURES

Desktop

Run RStudio on your desktop

RStudio Desktop ›

Server

Centralize access and computation

RStudio Server ›

RStudio Desktop

Open Source Edition	Commercial License

RStudio

Products Resources Pricing About Us Blog

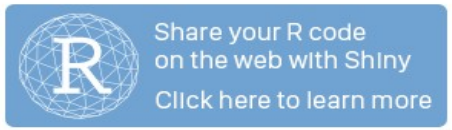
	Open Source Edition	Commercial License
Overview	• Access RStudio locally • Syntax highlighting, code completion, and smart indentation • Execute R code directly from the source editor • Quickly jump to function definitions • Easily manage multiple working directories using projects • Integrated R help and documentation • Interactive debugger to diagnose and fix errors quickly • Extensive package development tools	All of the features of open source; plus: • A commercial license for organizations not able to use AGPL software • Access to priority support
Support	Community forums only	• Priority Email Support • 8 hour response during business hours (ET)
License	AGPL v3	RStudio License Agreement
Pricing	Free	$995/year
b3)	DOWNLOAD RSTUDIO DESKTOP	BUY NOW

Luego, seleccionar la versión de RStudio correspondiente al Sistema Operativo.

b4) Luego, seleccionar una versión reciente de Rstudio de su Sistema Operativo y guardar dicho archivo.

RStudio Desktop 0.99.467 — Release Notes

RStudio requires R 2.11.1 (or higher). If you don't already have R, you can download it here.



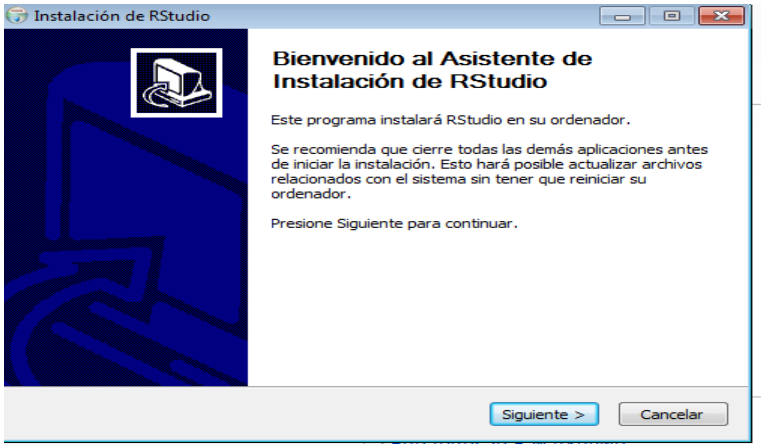
Installers for Supported Platforms

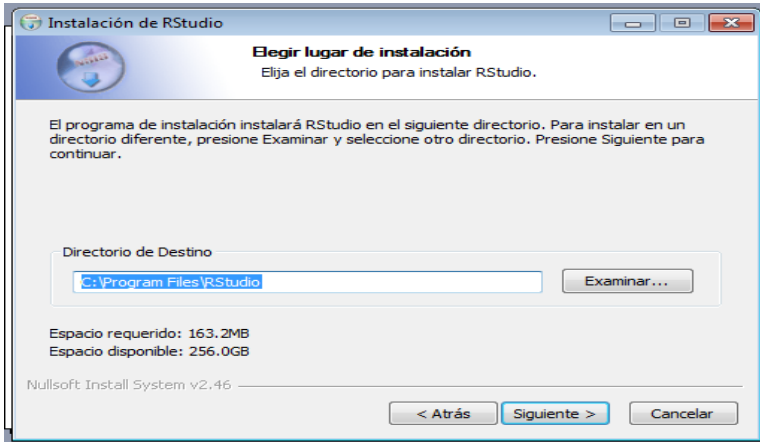
Installers	Size	Date	MD5
RStudio 0.99.467 - Windows Vista/7/8	73.9 MB	2015-07-15	5c0bf6987adcfb6dd441326ecc67f6e8
RStudio 0.99.467 - Mac OS X 10.6+ (64-bit)	56.2 MB	2015-07-15	3116a0f3b9b3779b9531e9b08c394558
RStudio 0.99.467 - Ubuntu 12.04+/Debian 8+ (32-bit)	77.4 MB	2015-07-15	0ca919255495cc87112df12a1cff7e29
RStudio 0.99.467 - Ubuntu 12.04+/Debian 8+ (64-bit)	83.9 MB	2015-07-15	dd64fc165de55a0be229f2362cd776da
RStudio 0.99.467 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	76.8 MB	2015-07-15	1e152bafa8b6c5355a2ec0f6822abdff
RStudio 0.99.467 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	77.6 MB	2015-07-15	a82a27b113184e1790ec5bd3c36e2137

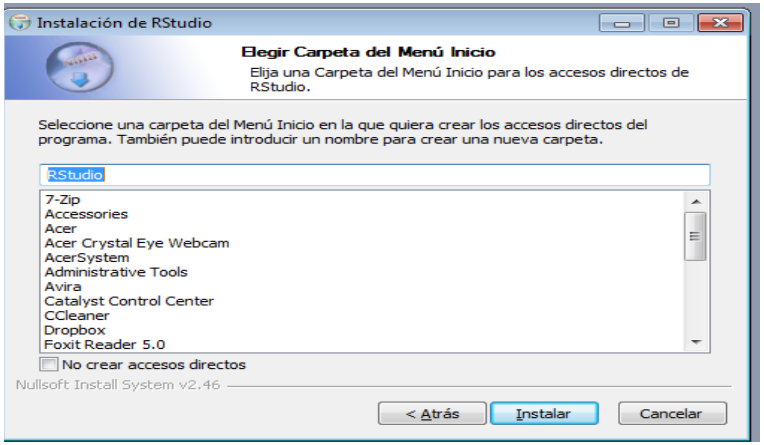
b5)

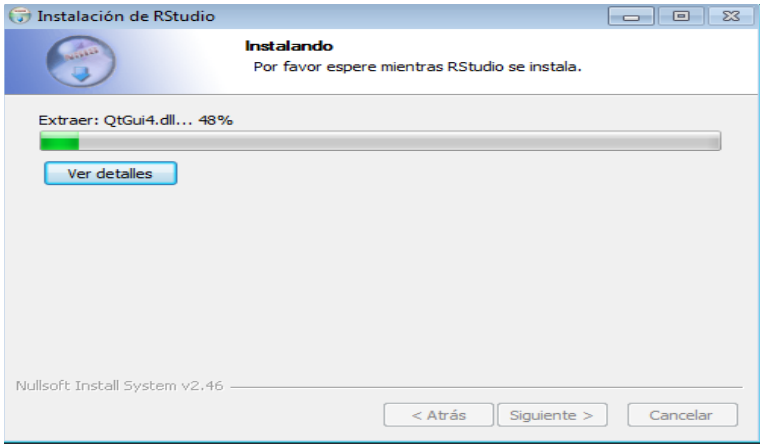
- En Windows: se obtiene archivo .exe de instalación.
- En Mac: se obtiene archivo .dmg de instalación.
- En Linux: guardar el archivo .deb e instalarlo con Ubuntu Software Center.

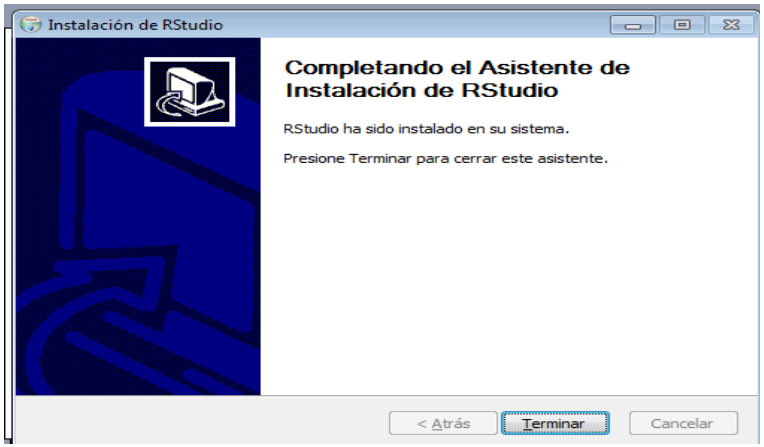
b6) En Windows, haciendo click en el archivo .exe:



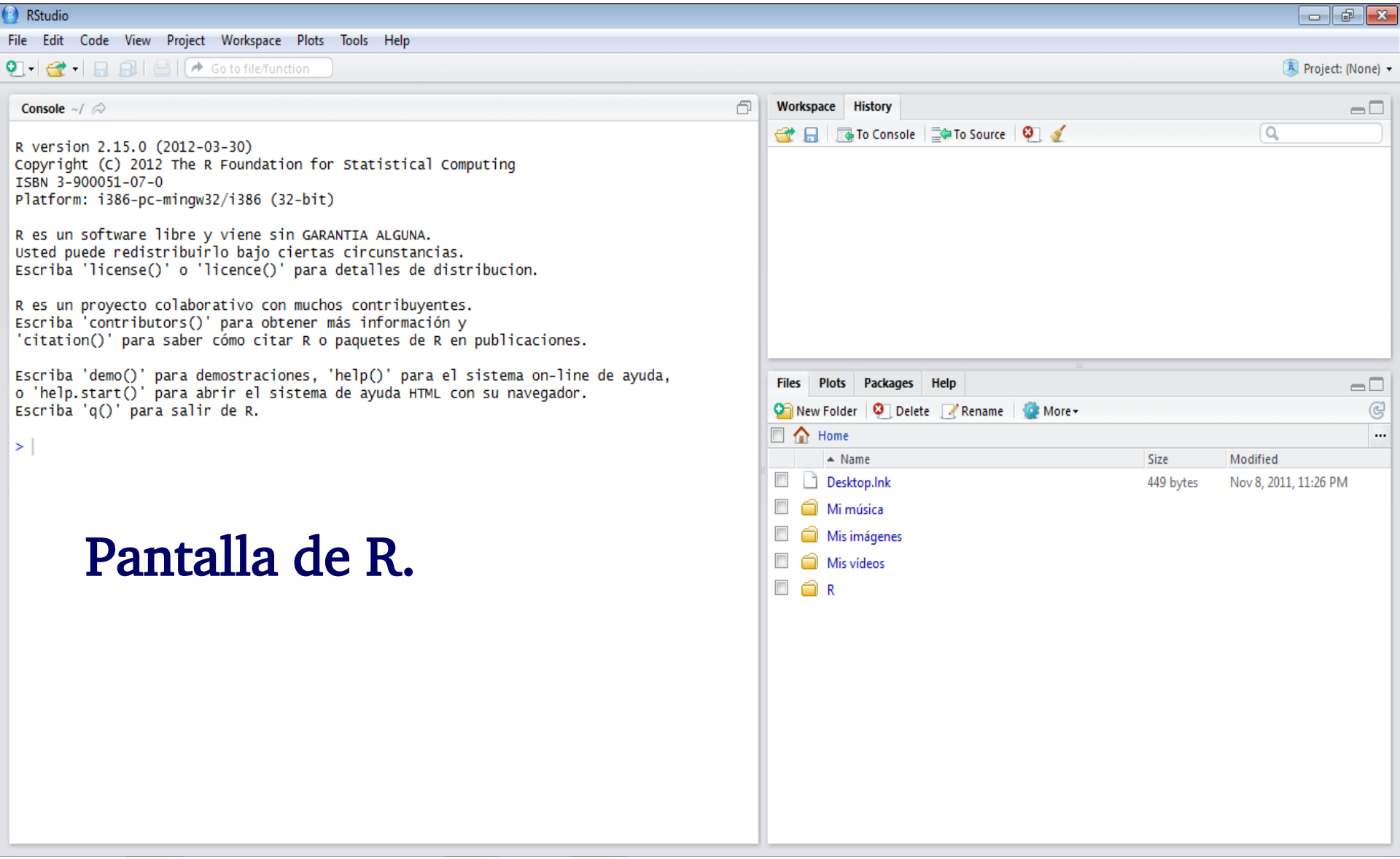








Al iniciar RStudio:



Pantalla de R.

Las pantallas de RStudio (con datos y análisis):

RStudio

File Edit View Project Workspace Plots Tools Help

diamondPricing.R* | formatPlot.R | diamonds

Source on Save | Run | Source

```
1  library(ggplot2)
2
3  View(diamonds)
4  summary(diamonds)
5
6  summary(diamonds$price)
7  aveSize <- round(mean(diamonds$carat), 4)
8  clarity <- levels(diamonds$clarity)
9
10 p <- qplot(carat, price,
11            data=diamonds, color=clarity,
12            xlab="Carat", ylab="Price",
13            main="Diamond Pricing")
14
```

14:1 (Top Level) R Script

Script

Workspace | History

Load | Save | Import Dataset | Clear All

Data	
diamonds	53940 obs. of 10 variables
Values	
aveSize	0.7979
clarity	character[8]
p	ggplot[8]
Functions	
format.plot(plot, size)	

Gestión de variables

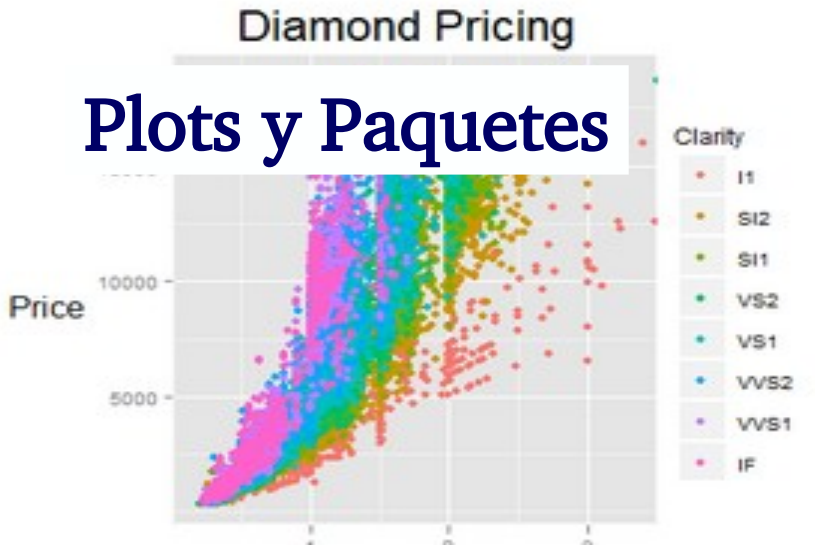
Console ~/

```
       x                y                z
 Min.   : 0.000   Min.   : 0.000   Min.   : 0.000
 1st Qu.:                          Qu.: 2.910
 Median                            ian : 3.530
 Mean                              n   : 3.539
 3rd Qu.: 6.540   3rd Qu.: 6.540   3rd Qu.: 4.040
 Max.   :10.740   Max.   :58.900   Max.   :31.800
> summary(diamonds$price)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    326     950    2401    3933    5324   18820
> aveSize <- round(mean(diamonds$carat), 4)
> clarity <- levels(diamonds$clarity)
> p <- qplot(carat, price,
+            data=diamonds, color=clarity,
+            xlab="Carat", ylab="Price",
+            main="Diamond Pricing")
>
```

Pantalla de R.

Files | Plots | Packages | Help

Zoom | Export | Clear All



Plots y Paquetes

c) Instrucciones para instalar JAGS, INLA y Stan

Estos tres programas hacen lo mismo: simulan un proceso de Monte Carlo para estimar parámetros de modelos estadísticos.

Pero emplean diferentes algoritmos que tienen ventajas relativas para diferentes tipos/cantidad de datos y para diferentes clases de modelos estadísticos.

Luego se explicarán los detalles, ahora se trata de instalarlos.

c1) JAGS: http://mcmc-jags.sourceforge.net/

What is JAGS?

JAGS is Just Another Gibbs Sampler. It is a program for analysis of Bayesian hierarchical models using Markov Chain Monte Carlo (MCMC) simulation not wholly unlike BUGS. JAGS was written with three aims in mind:

- To have a cross-platform engine for the BUGS language
- To be extensible, allowing users to write their own functions, distributions and samplers.
- To be a platform for experimentation with ideas in Bayesian modelling

JAGS is licensed under the GNU General Public License version 2. You may freely modify and redistribute it under certain conditions (see the file

News

See the JAGS NEWS blog for news about the project. If you want to be kept informed of updates to JAGS, then subscribe to the RSS news feed.

Latest version

The latest release is JAGS 4.3.0. It was released on July 18 2017.

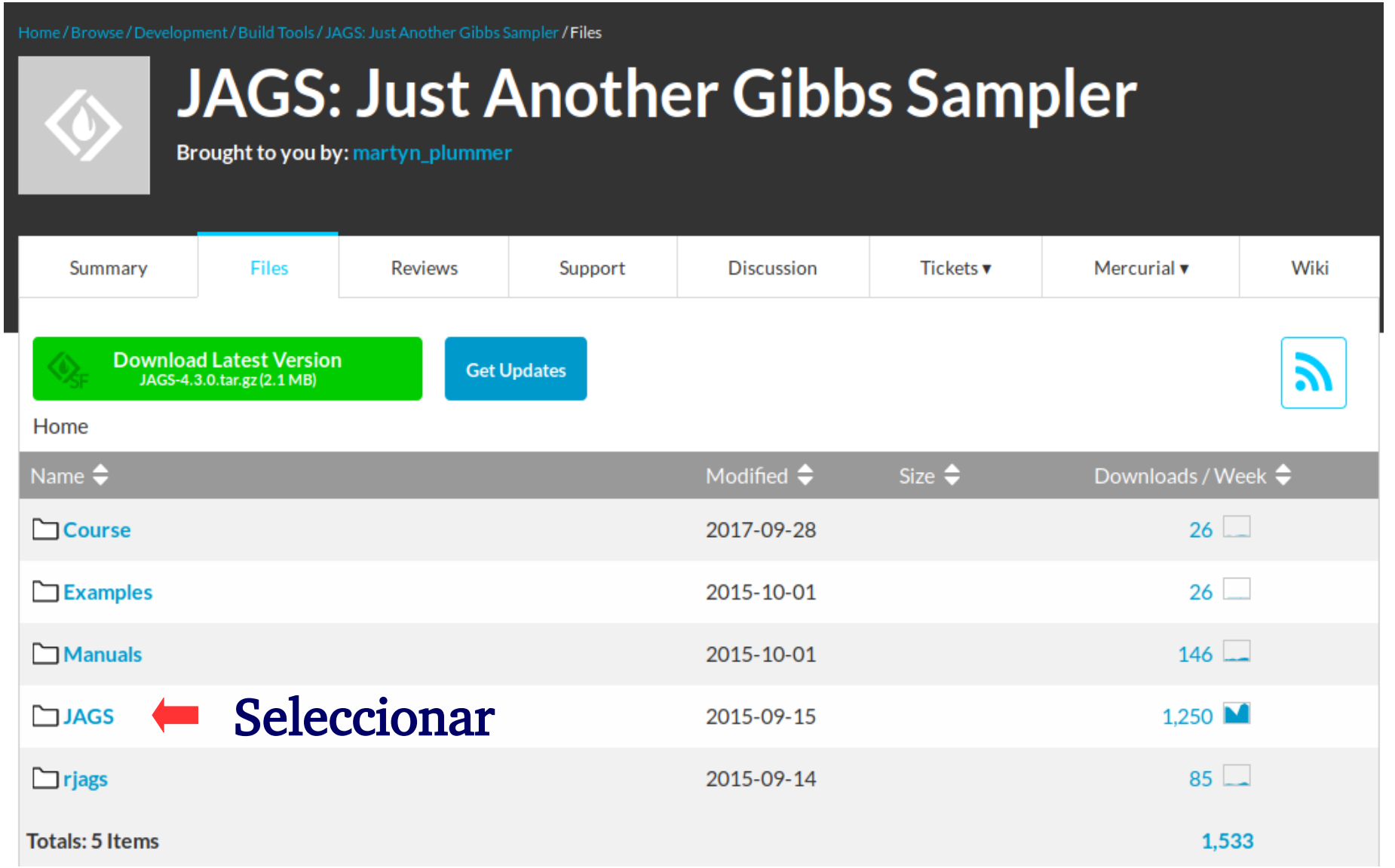
Downloads

To download JAGS, please visit the files page of the mcmc-jags project at sourceforge. You will find the source for JAGS there as well as binary packages for Mac OS X (Thanks to Matt Denwood and the pioneering work of Bill Northcott) and Windows.

INSTALEN JAGS.

Lo vamos a usar el último día.

c1.1) https://sourceforge.net/projects/mcmc-jags/files/



Seleccionar

c1.2)

https://sourceforge.net/projects/mcmc-jags/files/JAGS

En la siguiente ventana se selecciona el Sistema Operativo: Windows o Mac (para Linux ver luego)

c1.3)

Home / Browse / Development / Build Tools / JAGS: Just Another Gibbs Sampler / Files

JAGS: Just Another Gibbs Sampler

Brought to you by: martyn_plummer

Summary | Files | Reviews | Support | Discussion | Tickets ▾ | Mercurial ▾ | Wiki

Download Latest Version
JAGS-4.3.0.tar.gz (2.1 MB)

Get Updates

Home / JAGS / 4.x

Name	Modified	Size	Downloads / Week
Parent folder			
Windows	2017-08-10		766
Mac OS X	2017-07-19		267
Source	2017-07-18		164

Totals: 3 Items

En ambos casos, guardar archivo e instalarlo en su laptop.

c1.4)

Home / JAGS / 4.x / Windows

Name	Modified	Size	Downloads / Week
Parent folder			
JAGS-4.3.0.exe	2017-08-10	33.9 MB	705
JAGS-4.2.0.html	2016-06-22	1.6 kB	
README	2016-04-05	455 Bytes	12

Home / JAGS / 4.x / Mac OS X

Name	Modified	Size	Downloads / Week
Parent folder			
README	2017-07-19	3.2 kB	4
JAGS-4.3.0.dmg	2017-07-19	2.3 MB	250
JAGS-4.2.0.dmg	2016-02-23	1.8 MB	5

c1.5) Linux: muchas formas de hacer esta instalación.

Lo más simple es hacerlo desde el Terminal:

Ubuntu 14.04 (y versiones previas, supongo)
sudo apt-add-repository ppa:marutter/rrutter
sudo apt-get update

Ubuntu 18.04 (y versiones más recientes, supongo)
sudo apt-get install jags

INSTALEN JAGS.
Lo vamos a usar el último día.

c) INLA y Stan:

INLA y Stan son programas independientes que

- se pueden utilizar directamente o
- (mucho mejor aún) a través de librerías específicas de R como INLA y rstan o brms o rstanarm.

Lo que hacen estas librerías es:

- transformar el modelo escrito en R a código C++,
- ejecutar el código C++,
- devolver a RStudio el output de los modelos como objetos R para ser visualizado e interpretado.

Por ende, para emplear estos programas se requiere que uds tengan un compilador C++ instalado.

El PRIMER PASO es verificar si ya tienen un compilador C++ instalado.

En RStudio, escribir:

```
pkgbuild::has_build_tools(debug = TRUE)
```

Si la respuesta es TRUE, ud. tiene el C++ toolchain correctamente instalado y solo hay que instalar las librerías que harán la interfase entre R y INLA/Stan (ver más adelante en este documento).

Si la respuesta es FALSE, hay que instalar el compilador C++ y hacer el link con con Rstudio.

La instalación del compilador de C++ difiere entre Windows, Mac y Linux.

Casos posibles (siempre desde RStudio):

1) Usuarios de Windows: en la verificación anterior, una ventana pop-up permitirá instalar Rtools (que compila librerías de R a partir de códigos fuente). Clickear Yes y esperar a que la instalación termine.

Luego, hacer: install.packages("devtools")

Configurar la C++ Toolchain desde RStudio:

```
dotR <- file.path(Sys.getenv("HOME"), ".R")
if (!file.exists(dotR)) dir.create(dotR)
M<-file.path(dotR, ifelse(.Platform$OS.type== "windows", "Makevars.win", "Makevars"))
if (!file.exists(M)) file.create(M)
cat("\nCXX14FLAGS=-O3 -march=native -mtune=native",
 if( grepl("^darwin", R.version$os)) "CXX14FLAGS += -arch x86_64 -ftemplate-depth-256"
else
 if (.Platform$OS.type == "windows") "CXX11FLAGS=-O3 -march=native -mtune=native"
else
   "CXX14FLAGS += -fPIC",  file = M, sep = "\n", append = TRUE)
```

2) Usuarios de Mac: Instalar el macOS R toolchain

Bajarlo desde http://go.illinois.edu/r-macos-rtools-pkg.

Abrir el instalador con doble click, y proceder como con otros instaladores tipo macOS.

Ver detalles en: https://github.com/rmacoslib/r-macos-rtools#how-do-i-use-the-installer

3) Usuarios de Linux: desde el Terminal:

```
sudo add-apt-repository -y "ppa:marutter/rrutter"
sudo add-apt-repository -y "ppa:marutter/c2d4u"
sudo apt-get update
sudo apt-get install r-cran-rstan
```

Configura Rtools desde Rstudio: →

```
dotR <- file.path(Sys.getenv("HOME"), ".R")
if (!file.exists(dotR)) dir.create(dotR)
M <- file.path(dotR, "Makevars")
if (!file.exists(M)) file.create(M)
cat("\nCXX14FLAGS=-O3 -march=native -mtune=native -fPIC",
    "CXX14=g++", # or clang++ but you may need a version postfix
    file = M, sep = "\n", append = TRUE)
```

c2) INLA: Integrated Nested Laplace Approximation

Una vez instalado el compilador de C++, se pueden instalar las librerías de R que harán la interfase entre R y los programas INLA y Stan.

Para instalar la librería INLA desde RStudio:

```
install.packages("INLA", repos=c(getOption("repos"), INLA="
https://inla.r-inla-download.org/R/testing"), dep=TRUE)
```

```
library(INLA)
```

```
inla.update(testing=T)
```

Para verificar, escribir (ajusta una regresión):

```
inla(formula=y~1,data=list(y=1:9))
```

c3) STAN: implementa Hamiltonian Monte Carlo

Para instalar la librería rstan desde RStudio:

```
install.packages("rstan",dependencies=TRUE)
library(rstan)
m1<-"parameters {real y[2];}
        model {y[1] ~ normal(0, 1);
               y[2] ~double_exponential(0, 2);} "
```

Para verificar la instalación de Stan:

```
fit1<- stan(model_code=m1, iter=10, verbose=F)
print(fit1)
```

Las otras librerías (brms, rstanarm) se instalarán como cualquier librería de R.

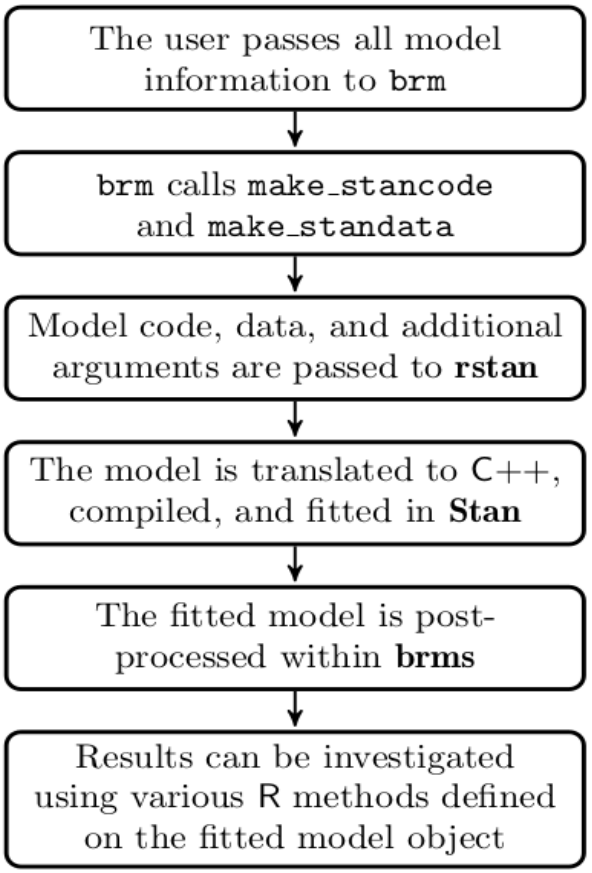
Luego de instalar brms, para verificar escribir:

```
brm(mpg~hp, data = mtcars)
```

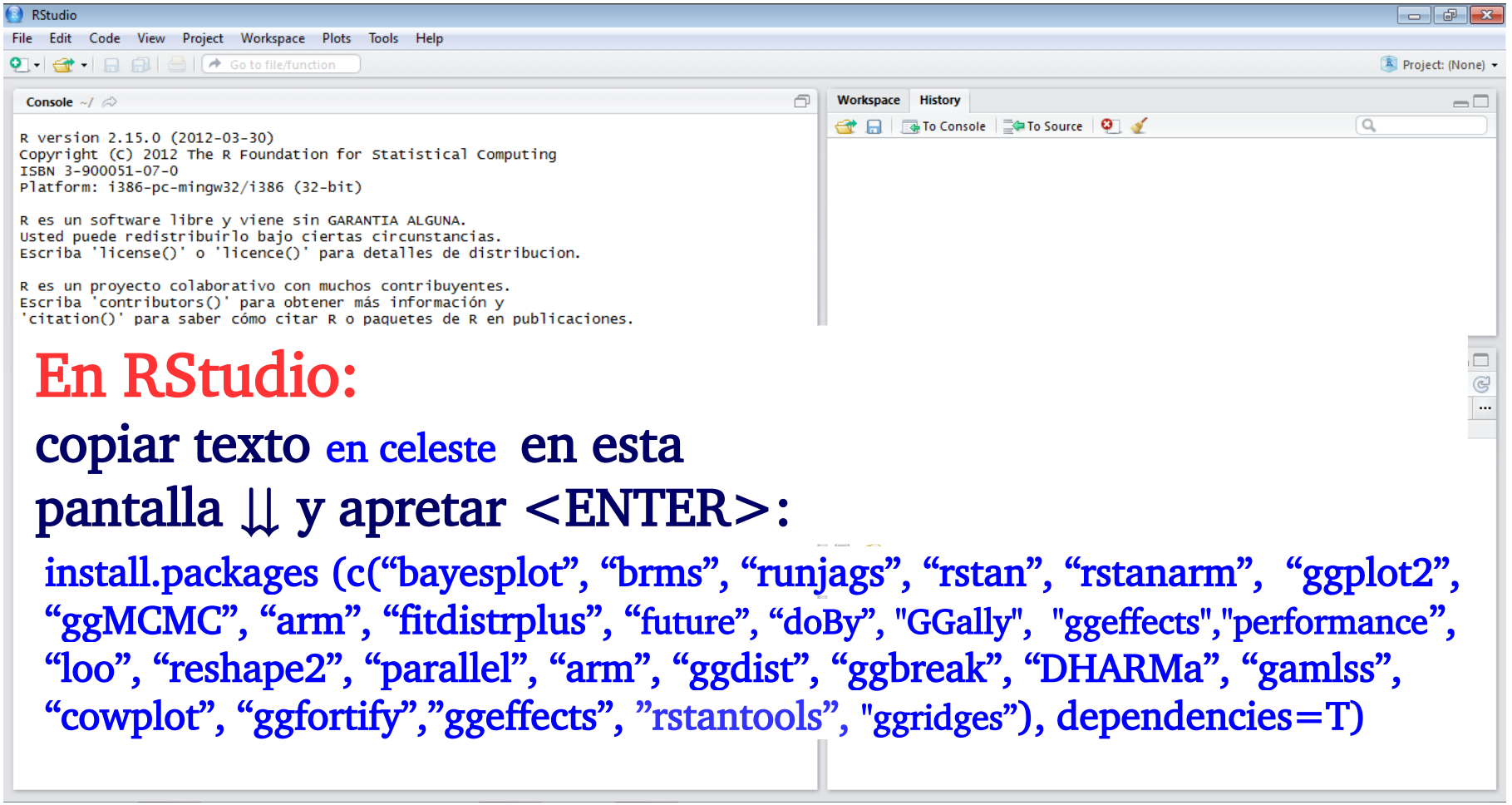
Si hay compilación del modelo, todo está OK.

En el caso de Stan, además de usarlo a través de la librería rstan, las librerías rstanarm y brms que permiten estimar parámetros de Modelos Lineales Generalizados Mixtos (y otros similares en un sentido muuuy amplio) a través de rstan.

La idea es:



d) Paquetes adicionales de R usadas en este curso:



En RStudio:

copiar texto en celeste en esta pantalla ⇓ y apretar <ENTER>:

install.packages (c("bayesplot", "brms", "runjags", "rstan", "rstanarm", "ggplot2", "ggMCMC", "arm", "fitdistrplus", "future", "doBy", "GGally", "ggeffects","performance", "loo", "reshape2", "parallel", "arm", "ggdist", "ggbreak", "DHARMa", "gamlss", "cowplot", "ggfortify","ggeffects", "rstantools", "ggridges"), dependencies=T)

A veces las "comillas curvas" generan problemas al copiar y pegar el comando de más abajo. Si hay problemas, reemplazarlas por "comillas rectas" o por apóstrofes.