

# Análises Multivariada de dados e de Séries Temporais

***Tema 03b: Análise Multivariada – O Software R***

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*Prof. Dr. Juan A. Alcántara Núñez*

### Porque aprender o R?

- Software gratuito
- Todos os códigos são abertos, reproduzíveis e adaptáveis
- Desenvolvido para Windows, diversas plataformas UNIX e MacOS
- Comunidade acadêmica disseminando conhecimento (Grupos muito ativos; no Brasil, um bom grupo é o R\_STAT do yahoo)
- Criação da revista *The R Journal*
- Empresas privadas e públicas estão se atentando ao R (diminuição de despesas e flexibilidade de análises)
- Link com *C*, *C++* e *Fortran*
- Ótima documentação (alterações de versões e help's)

**“Não pergunte se o R é capaz de fazer algo!  
Pergunte como ele faz!”**

### O Que é o software R?

R é uma linguagem também um ambiente de desenvolvimento integrado para cálculos estatísticos e gráficos



### Um pouco de Historia

- ✓ Foi criada originalmente por Ross Ihaka e por Robert Gentleman no departamento de Estatística da universidade de Auckland, Nova Zelândia, e foi desenvolvido em um esforço colaborativo de pessoas em vários locais do mundo.



Ross Ihaka



Robert Gentleman

### O Que é o software R?

R é uma linguagem também um ambiente de desenvolvimento integrado para cálculos estatísticos e gráficos



### Um pouco de Historia

- ✓ R é uma linguagem e um ambiente similar (em versão libre) ao S ou S-Plus, podendo ser considerado uma implementação distinta do S com diferenças importantes. Muitos códigos escritos para o S podem ser executados inalterados no R.
- ✓ O nome R provém em parte das iniciais dos criadores (Ross Ihaka e Robert Gentleman ) e também de um jogo figurado com a linguagem S (da Bell Laboratories, antiga AT&T).
- ✓ S foi criado pelo prof. John M. Chambers e seu grupo na universidade de Stanford

Prof. John M. Chambers



### O software R e os softwares livres:

- ✓ O código fonte do R está disponível sob a licença **GNU GPL** (**GNU General Public License**) e as versões binárias pré-compiladas são fornecidas para Windows, Macintosh, e muitos sistemas operacionais Unix/Linux..



**GNU GPL:** projeto iniciado por Richard Stallman em 1984, com o objetivo de criar um sistema operacional que seja totalmente livre. Stallman escolheu o nome **GNU** porque este nome, além da coincidência com o mamífero Gnu, é um acrônimo recursivo de: **GNU is Not Unix** (em português: **GNU Não é Unix**).



Richard  
Stallman



Logotipo  
GNU

## Software R

<http://www.r-project.org>



The R Project for Statistical Computing

The screenshot shows the official website for The R Project for Statistical Computing. On the left, there's a sidebar with links to 'About R', 'What is R?', 'Contributors', 'Screenshots', 'What's new?', 'Download, Packages', 'CRAN' (with a red arrow pointing to it), 'R Project Foundation', 'Members & Donors', 'Mailing Lists', 'Bug Tracking', 'Developer Page', 'Conferences', 'Search', 'Documentation', 'Manuals', 'FAQs', and 'The R Journal'. The main content area features several plots: a PCA plot titled 'PCA 5 vars' with variables Fertility, Catholic, Examination, Education, and Agriculture; a dendrogram for 'Clustering 4 groups'; two density plots for 'Groups 1' and 'Groups 2'; and a scatter plot with points colored by group (orange, green, pink) and labeled 'V. De Gereve'. At the bottom, a 'Getting Started:' section lists that R is a free software environment for statistical computing and graphics, compiled and run on UNIX.

PCA 5 vars  
princomp(x = data, cor = cor)

Fertility  
Catholic  
Examination  
Education  
Agriculture  
(1-3) 60%

Clustering 4 groups

Groups  
48 28  
16 1  
1 2

Factor 1 [41%]  
Factor 3 [19%]

V. De Gereve

Getting Started:

- R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX

http://www.r-project.org/misc/acpclust.R

Iniciar Entrada - brun... Microsoft Pow... Documento1 - ... imagens R Console The R Project f... 15:27

## Procurando o R?

A screenshot of a Google search results page for the query "project R". The results are displayed in a standard Google search interface with various filters like "Todas", "Vídeos", "Shopping", etc. The first result, "R: The R Project for Statistical Computing", is highlighted with an orange circle and an arrow pointing to it from the left. This result includes the URL <https://www.r-project.org/>, a "Traduzir esta página" link, and a brief description: "R, also called GNU S, is a strongly functional language and environment to statistically explore data sets, make many graphical displays of data from custom ...". Below this, there are other search results for "Download R-3.2.4 for Windows", "Project R - World of Warships", "Project R: Collect 260 Pearls and get Kamikaze R ...", "R-project download - Baixaki", and "R (programming language) - Wikipedia, the free encyclopedia". Each result has its URL, a "Traduzir esta página" link, and a brief description.

## Baixando o R:

The screenshot shows a web browser displaying the official R Project website at <https://www.r-project.org>. The page features the R logo and navigation links for Home, Download, CRAN, R Project, About R, Logo, Contributors, What's New?, Mailing Lists, Bug Tracking, Development Site, Conferences, and Search. The 'Download' link is highlighted with a red oval. The main content area displays the 'Getting Started' section, which describes R as a free software environment for statistical computing and graphics. It includes a link to download R from a CRAN mirror. Below this is the 'News' section, which lists several recent events and releases, such as the notice for XQuartz users, the release of R version 3.2.4, and the availability of the R logo.

**The R Project for Statistical Computing**

**Getting Started**

R is a free software environment for statistical computing and graphics. It compiles and runs on many platforms, Windows and MacOS. To [download R](#), please choose your preferred CRAN mirror.

If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

**News**

- **Notice XQuartz users (Mac OS X)** A security issue has been detected with the Sparkle update mechanism used by XQuartz. Avoid updating over insecure channels.
- **R version 3.2.4 (Very Secure Dishes)** has been released on Thursday 2016-03-10.
- **R version 3.3.0 (Supposedly Educational) prerelease versions** will appear starting Monday 2016-03-14. Final release is scheduled for Thursday 2016-04-14.
- The [R Logo](#) is available for download in high-resolution PNG or SVG formats.
- **useR! 2016**, will take place at Stanford University, CA, USA, June 27 - June 30, 2016.
- **The R Journal Volume 7/2** is available.
- **R version 3.2.3 (Wooden Christmas-Tree)** has been released on 2015-12-10.
- **R version 3.1.3 (Smooth Sidewalk)** has been released on 2015-03-09.

## Baixando o R:

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	<a href="https://cloud.r-project.org/">https://cloud.r-project.org/</a> <a href="http://cloud.r-project.org/">http://cloud.r-project.org/</a>	Automatic redirection to servers worldwide, currently sponsored by Rstudio Automatic redirection to servers worldwide, currently sponsored by Rstudio
Algeria	<a href="http://cran.usthb.dz/">http://cran.usthb.dz/</a>	University of Science and Technology Houari Boumediene
Argentina	<a href="http://mirror.fcaglp.unlp.edu.ar/CRAN/">http://mirror.fcaglp.unlp.edu.ar/CRAN/</a>	Universidad Nacional de La Plata
Australia	<a href="http://cran.csiro.au/">http://cran.csiro.au/</a> <a href="http://cran.ms.unimelb.edu.au/">http://cran.ms.unimelb.edu.au/</a>	CSIRO University of Melbourne
Austria	<a href="https://cran.wu.ac.at/">https://cran.wu.ac.at/</a> <a href="http://cran.wu.ac.at/">http://cran.wu.ac.at/</a>	Wirtschaftsuniversität Wien Wirtschaftsuniversität Wien
Belgium	<a href="http://www.freestatistics.org/cran/">http://www.freestatistics.org/cran/</a> <a href="https://lib.ugent.be/CRAN/">https://lib.ugent.be/CRAN/</a> <a href="http://lib.ugent.be/CRAN/">http://lib.ugent.be/CRAN/</a>	K.U.Leuven Association Ghent University Library Ghent University Library
Brazil	<a href="http://nbcgib.uesc.br/mirrors/cran/">http://nbcgib.uesc.br/mirrors/cran/</a> <a href="http://cran.r.c3sl.ufpr.br/">http://cran.r.c3sl.ufpr.br/</a> <a href="http://cran.fiocruz.br/">http://cran.fiocruz.br/</a> <a href="http://www.vps.fmvz.usp.br/CRAN/">http://www.vps.fmvz.usp.br/CRAN/</a> <a href="http://brieger.esalq.usp.br/CRAN/">http://brieger.esalq.usp.br/CRAN/</a>	Center for Comp. Biol. at Universidade Estadual de Santa Cruz Universidade Federal do Parana Oswaldo Cruz Foundation, Rio de Janeiro Sao Paulo, Sao Paulo University of Sao Paulo, Piracicaba
Canada	<a href="http://cran.stat.sfu.ca/">http://cran.stat.sfu.ca/</a> <a href="http://mirror.its.dal.ca/cran/">http://mirror.its.dal.ca/cran/</a> <a href="http://cran.utstat.utoronto.ca/">http://cran.utstat.utoronto.ca/</a>	Simon Fraser University, Burnaby Dalhousie University, Halifax University of Toronto
Chile	<a href="https://dirichlet.mat.puc.cl/">https://dirichlet.mat.puc.cl/</a>	Pontificia Universidad Catolica de Chile, Santiago

## Baixando o R:

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 (Thursday 2016-03-10, Very Secure Dishes) [R-3.2.4.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](#)

### Questions About R

- If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

What are R and CRAN?

R is 'GNU S', a freely available language and environment for statistical computing and graphics which provides a wide variety of statistical and graphical techniques: linear and nonlinear modelling, statistical tests, time series analysis, classification, clustering, etc. Please consult the [R project](#)

## Tema 03b: Software R

## Baixando o R:

The Comprehensive R Arc... +

www.vps.fmvz.usp.br/CRAN/ Pesquisar

# R for Windows

**Subdirectories:**

- [base](#) Binaries for base distribution (managed by Duncan Murdoch). This is what you want to [install R for the first time](#).
- [contrib](#) Binaries of contributed CRAN packages (for R >= 2.11.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 < 2.11.x; managed by Uwe Ligges).
- [Rtools](#) Tools to build R and R packages (managed by Duncan Murdoch). This is what you want to build your own packages on Windows, or to build R itself.

Please do not submit binaries to CRAN. Package developers might want to contact Duncan Murdoch or 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.

**CRAN**

[Mirrors](#)

[What's new?](#)

[Task Views](#)

[Search](#)

[About R](#)

[R Homepage](#)

[The R Journal](#)

**Software**

[R Sources](#)

[R Binaries](#)

[Packages](#)

[Other](#)

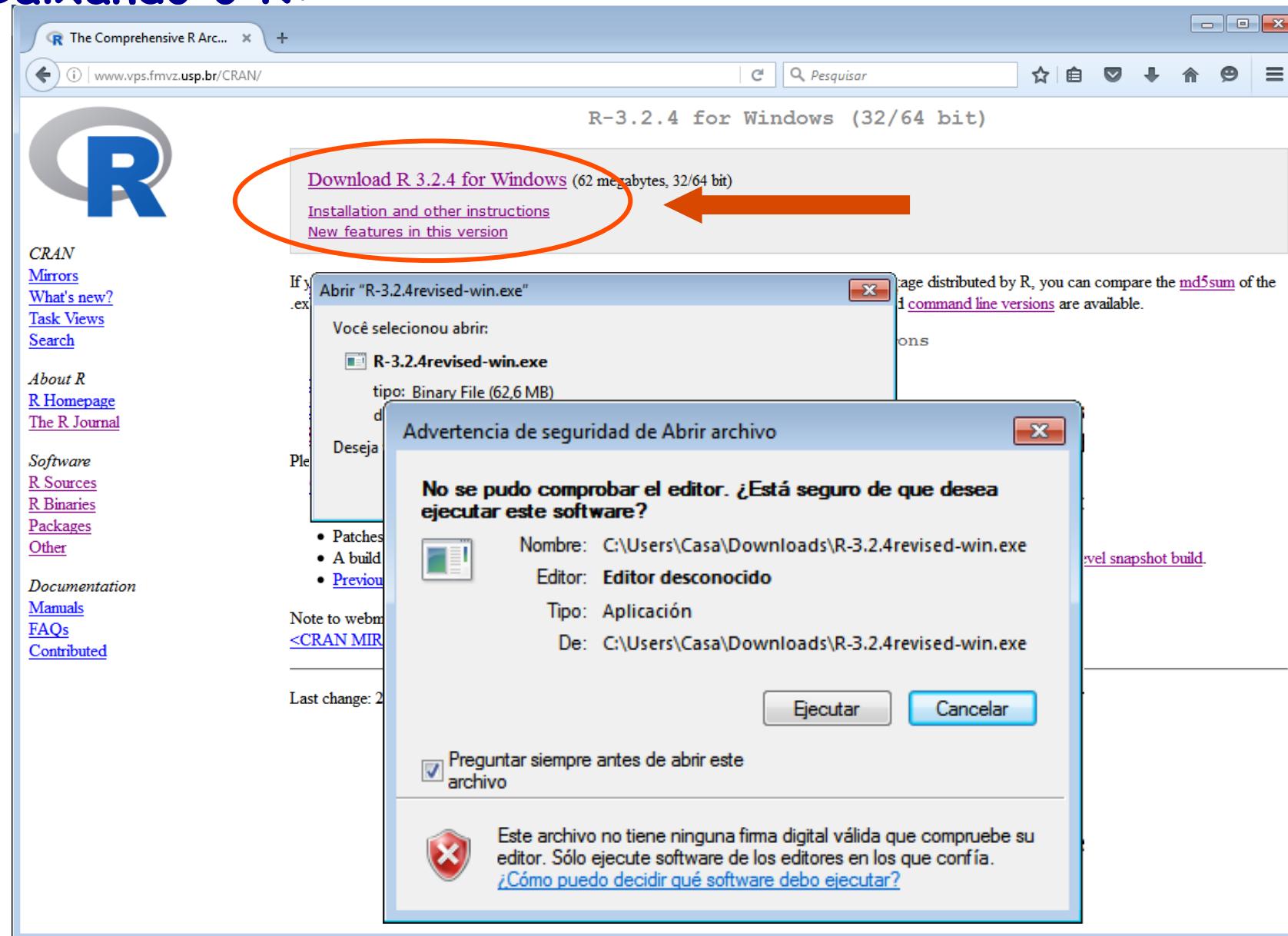
**Documentation**

[Manuals](#)

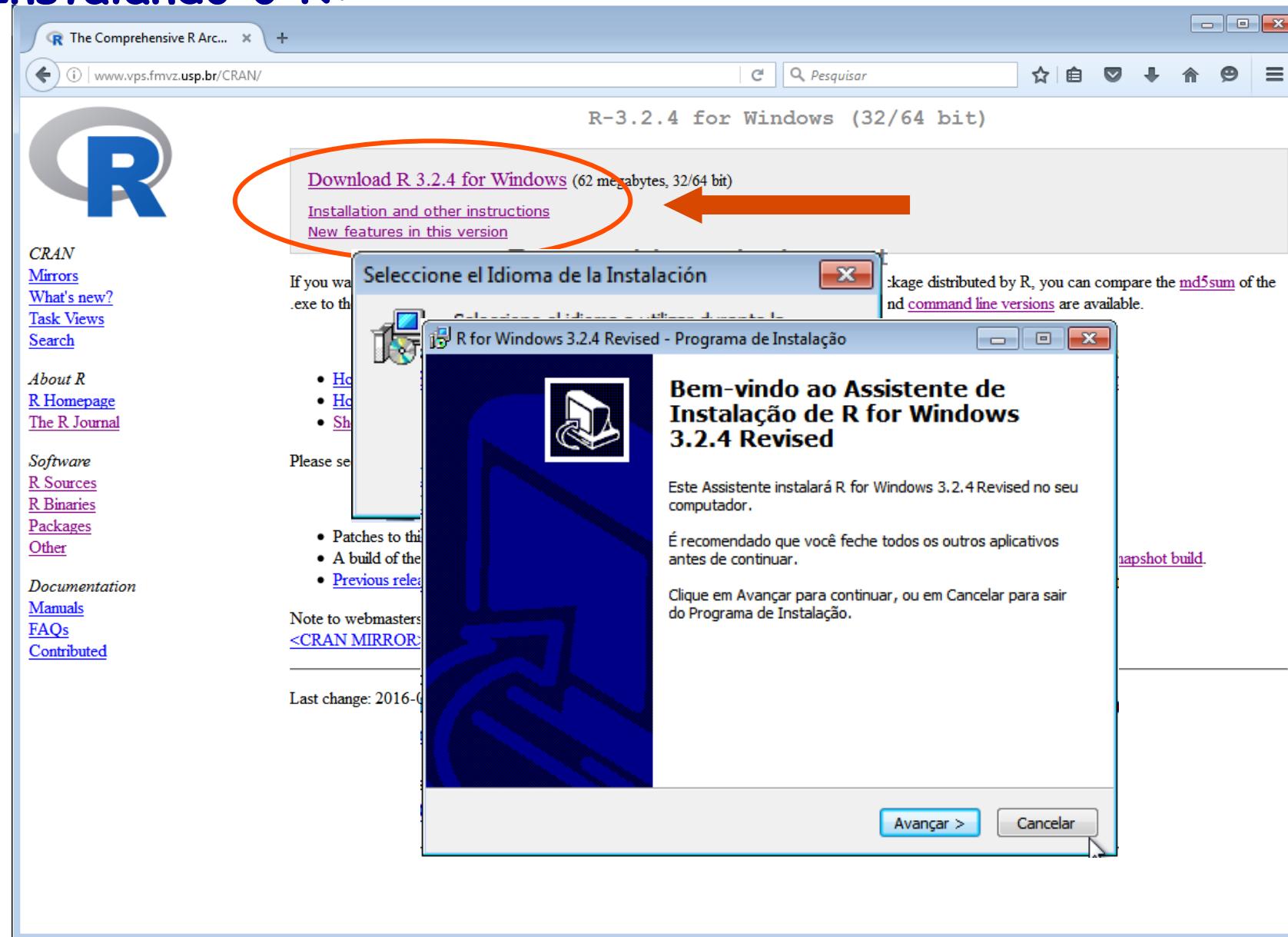
[FAQs](#)

[Contributed](#)

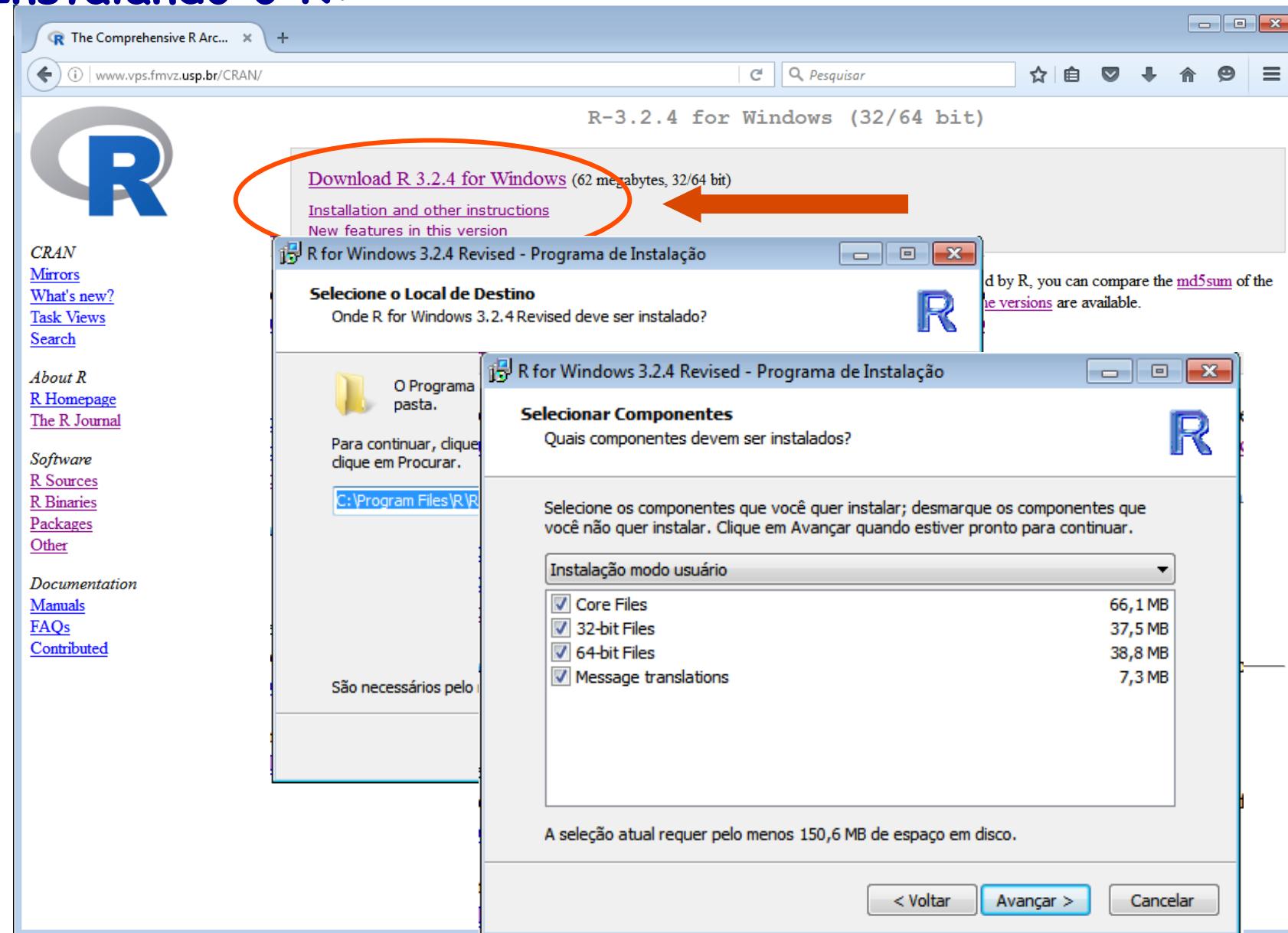
## Baixando o R:



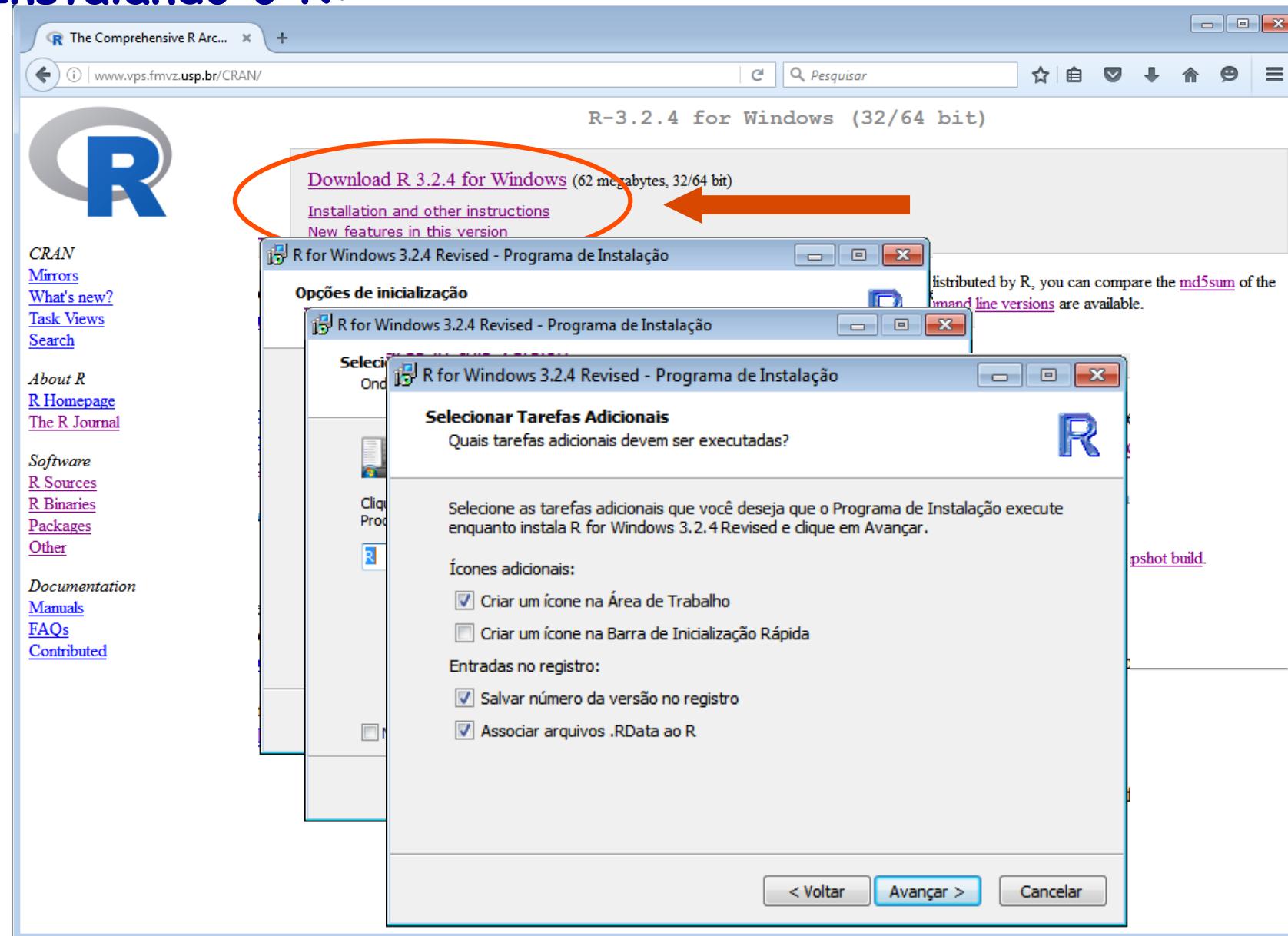
## Instalando o R:



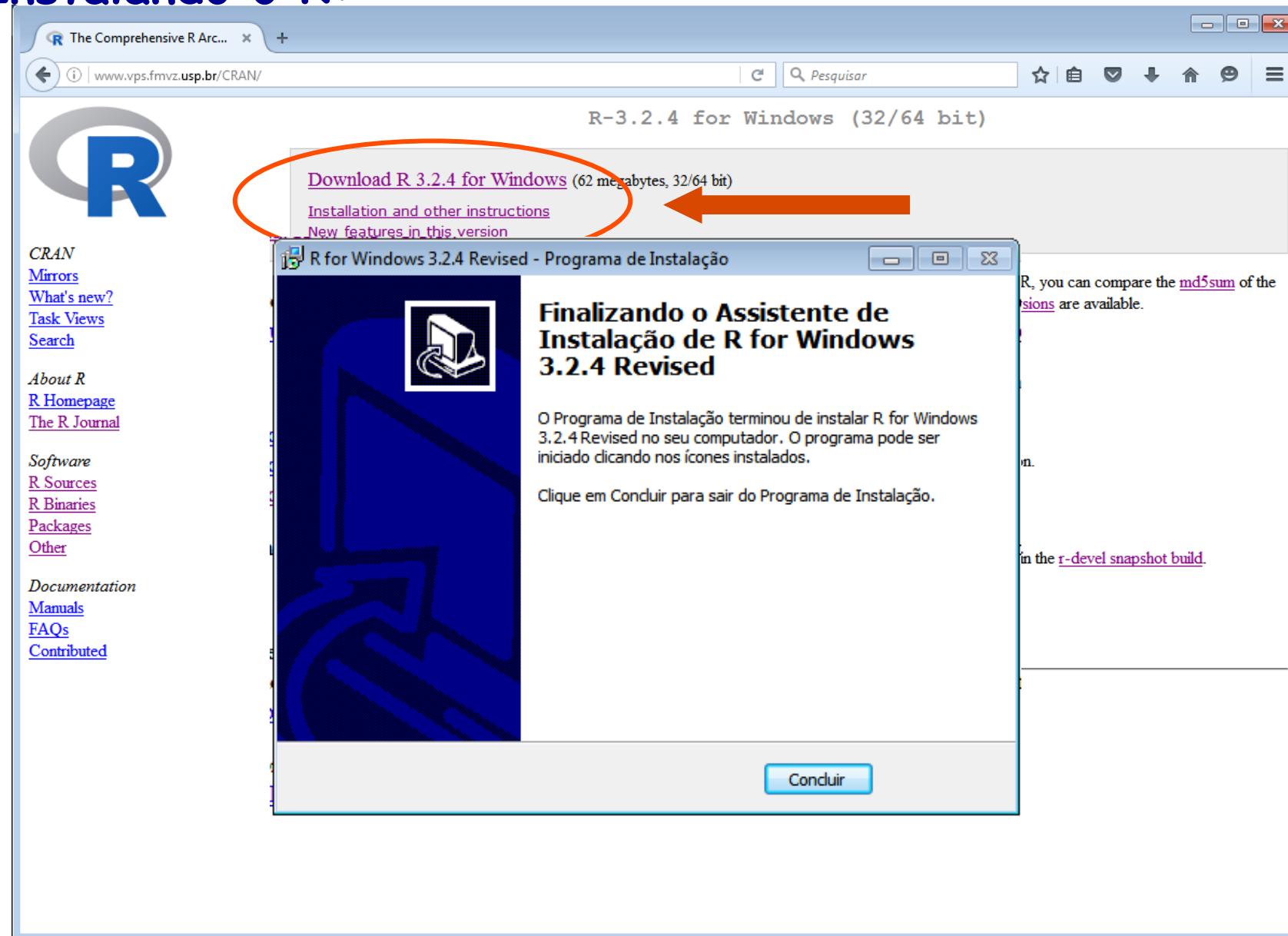
## Instalando o R:



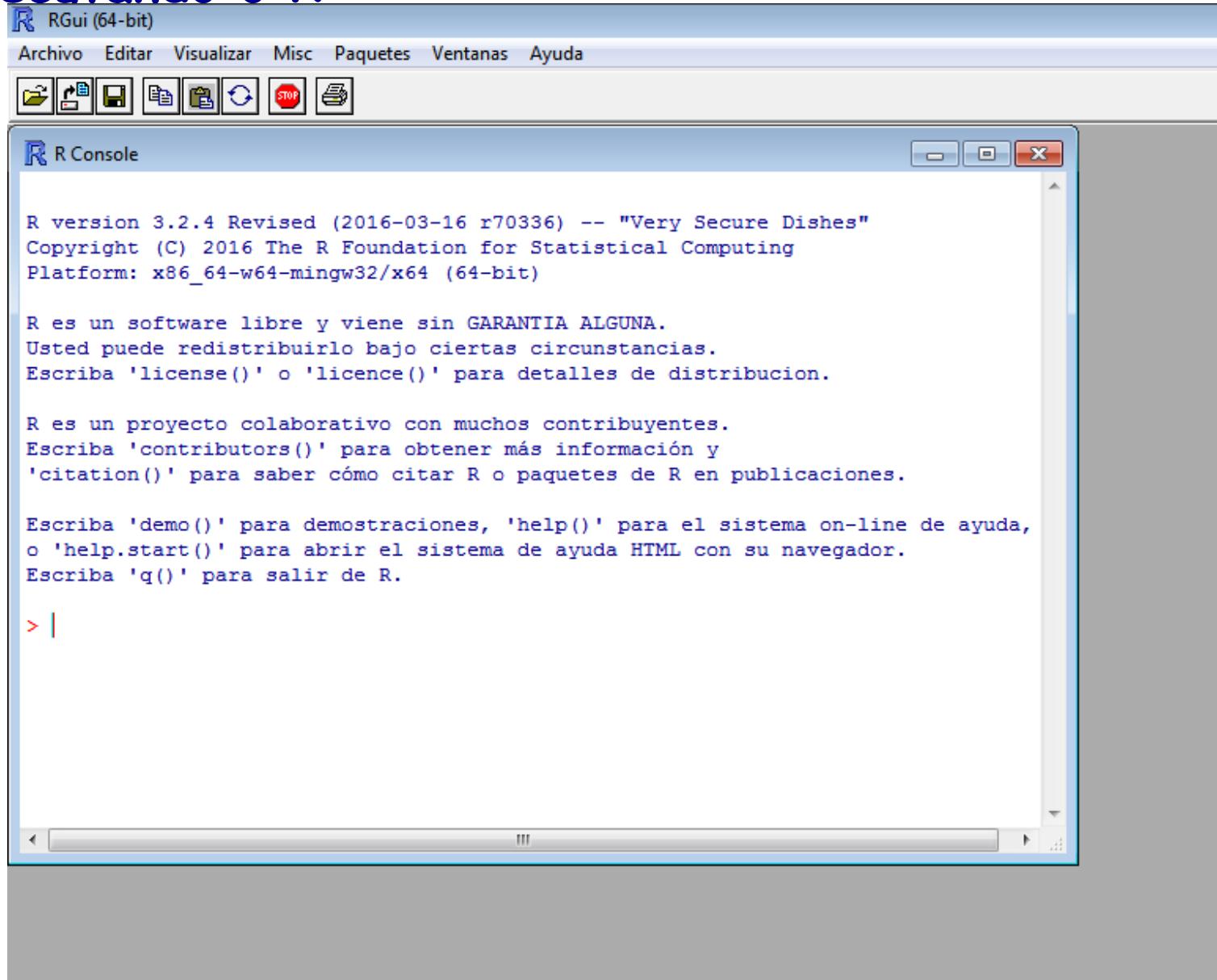
## Instalando o R:



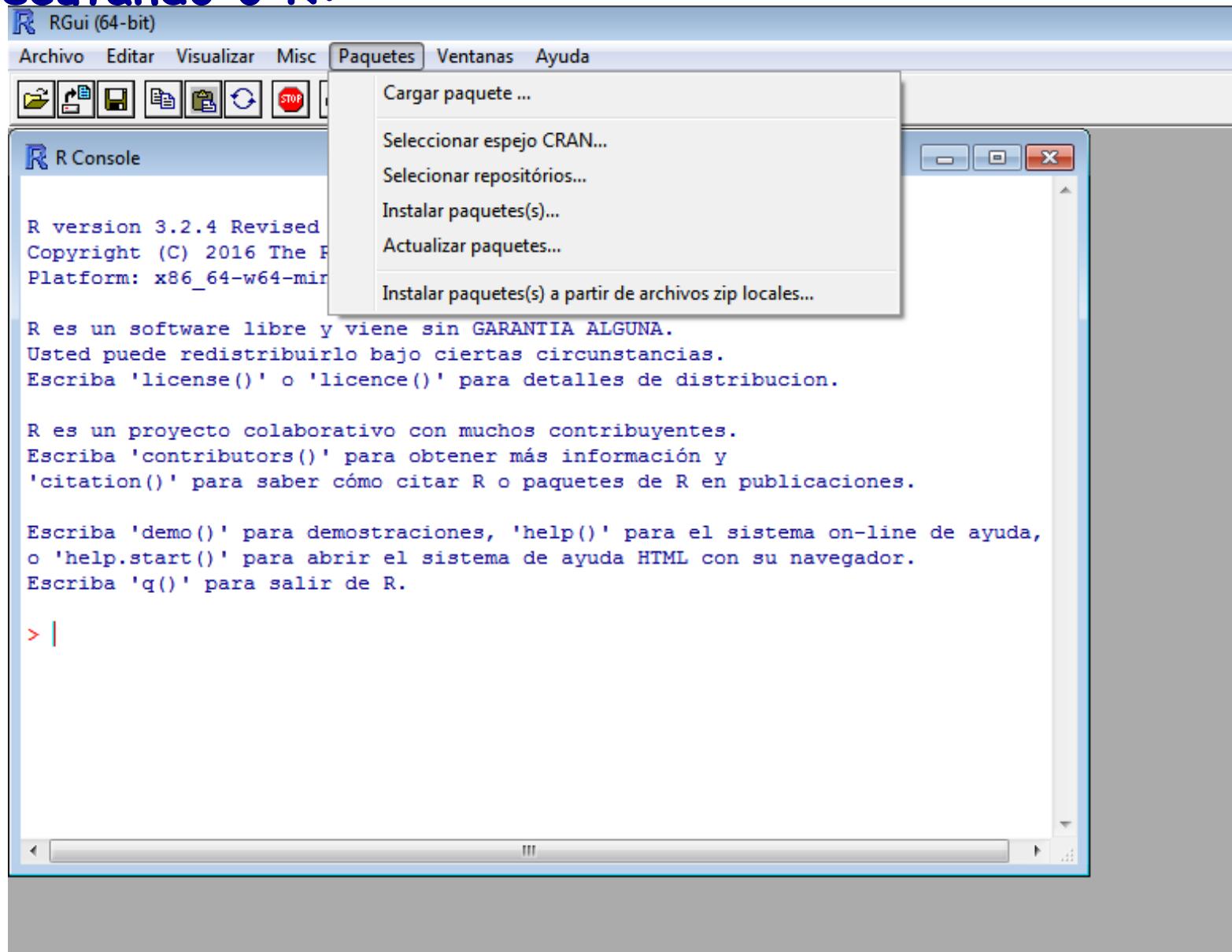
## Instalando o R:



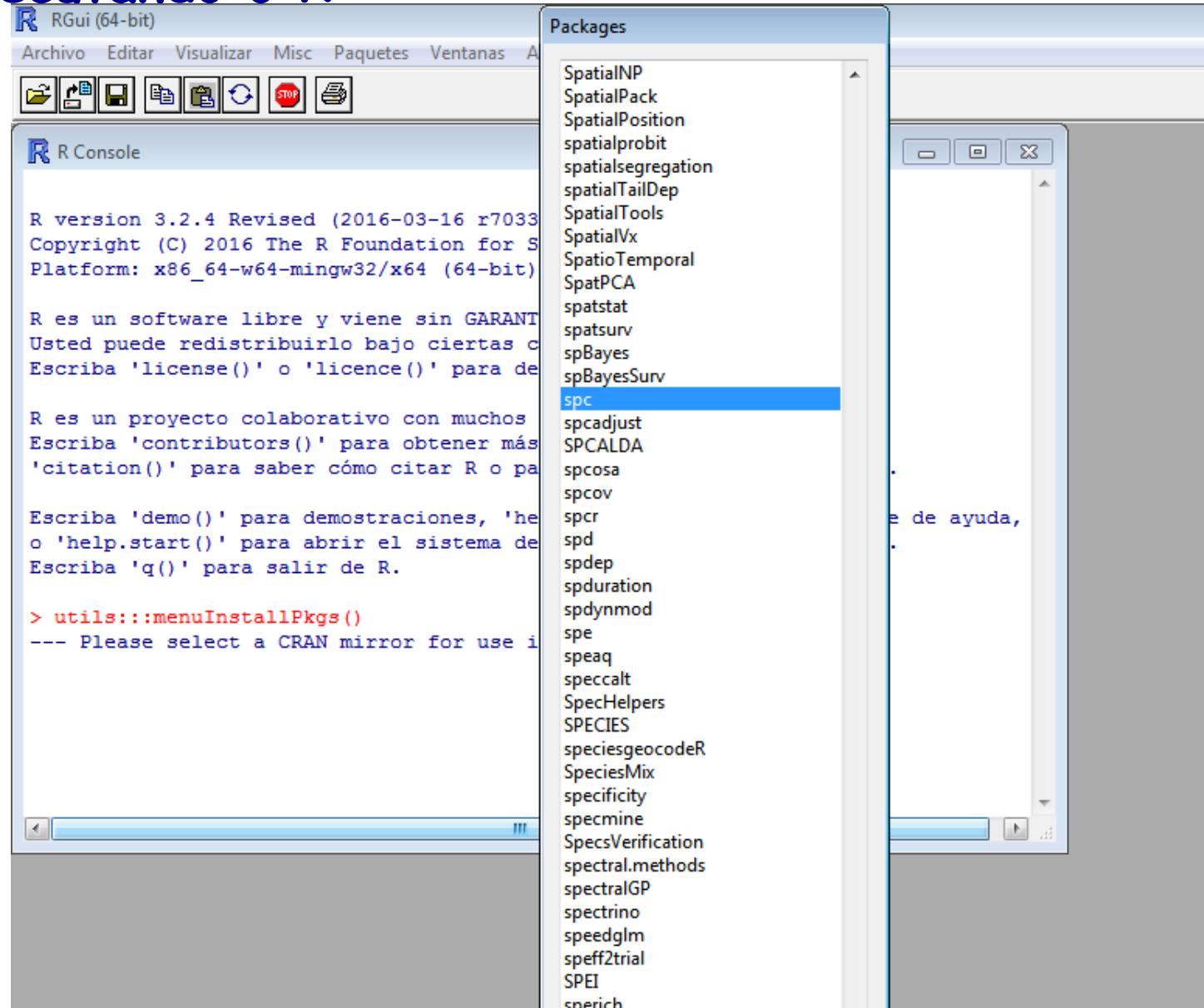
## Executando o R:



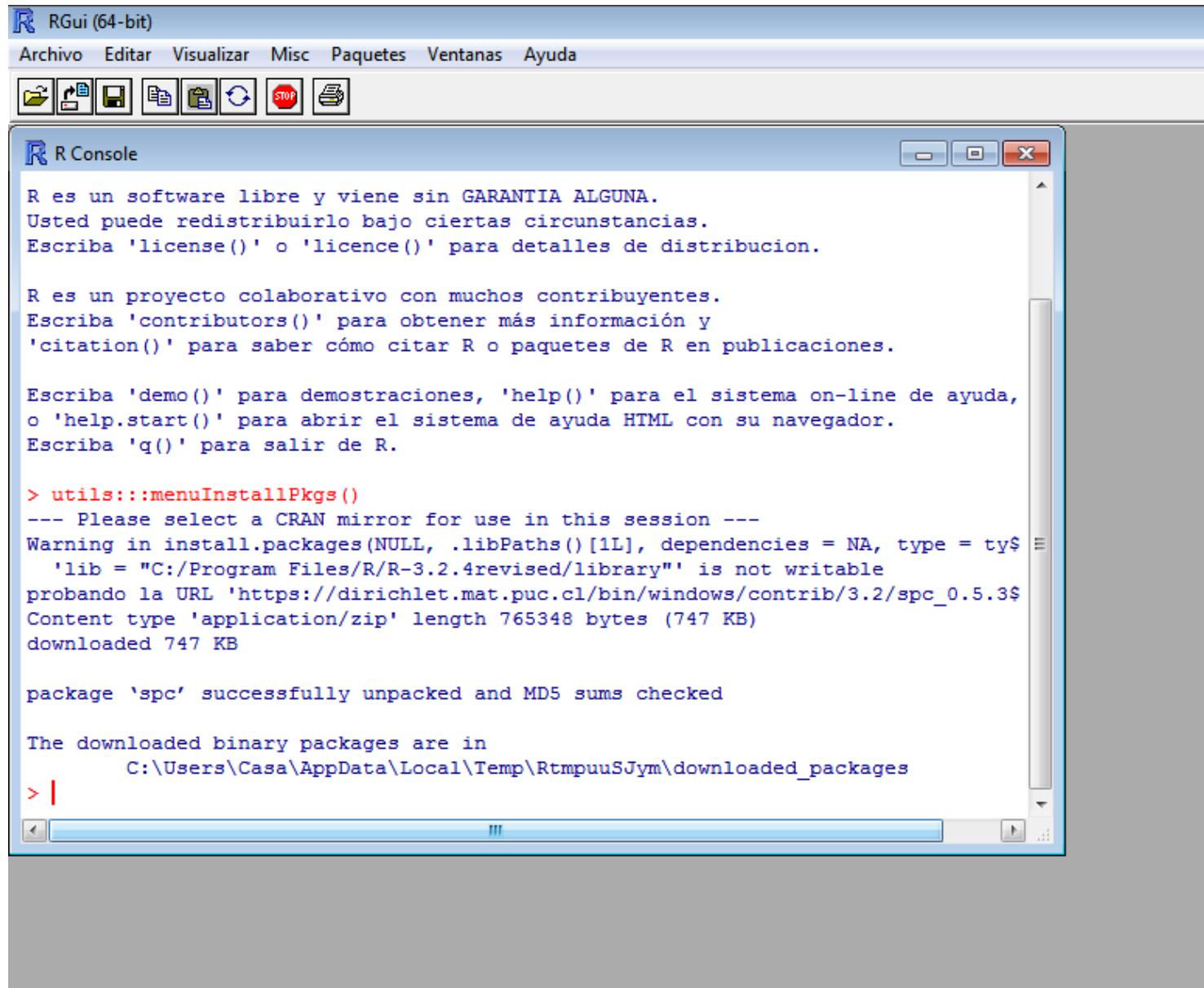
## Executando o R:



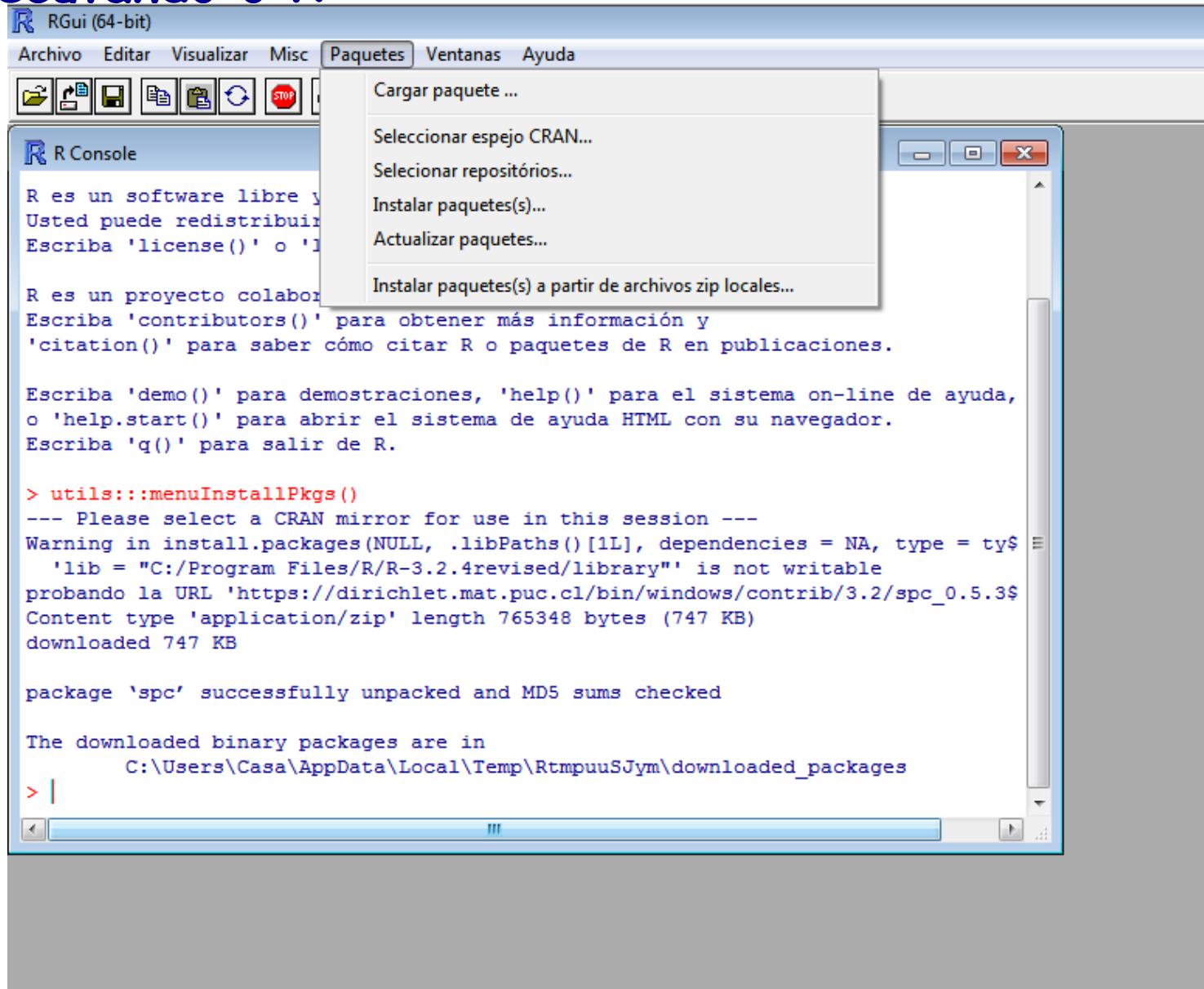
## Executando o R:



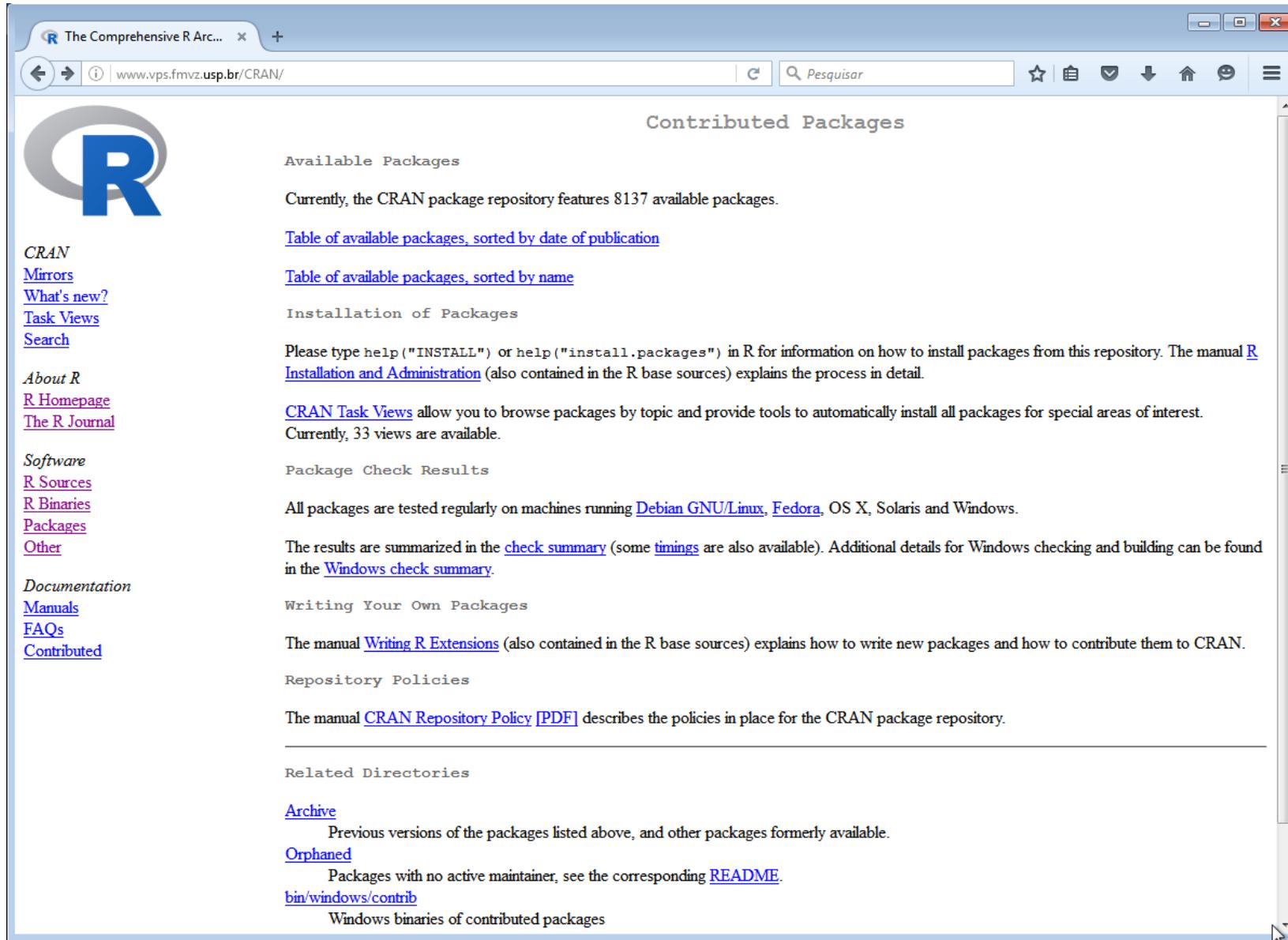
## Executando o R:



## Executando o R:

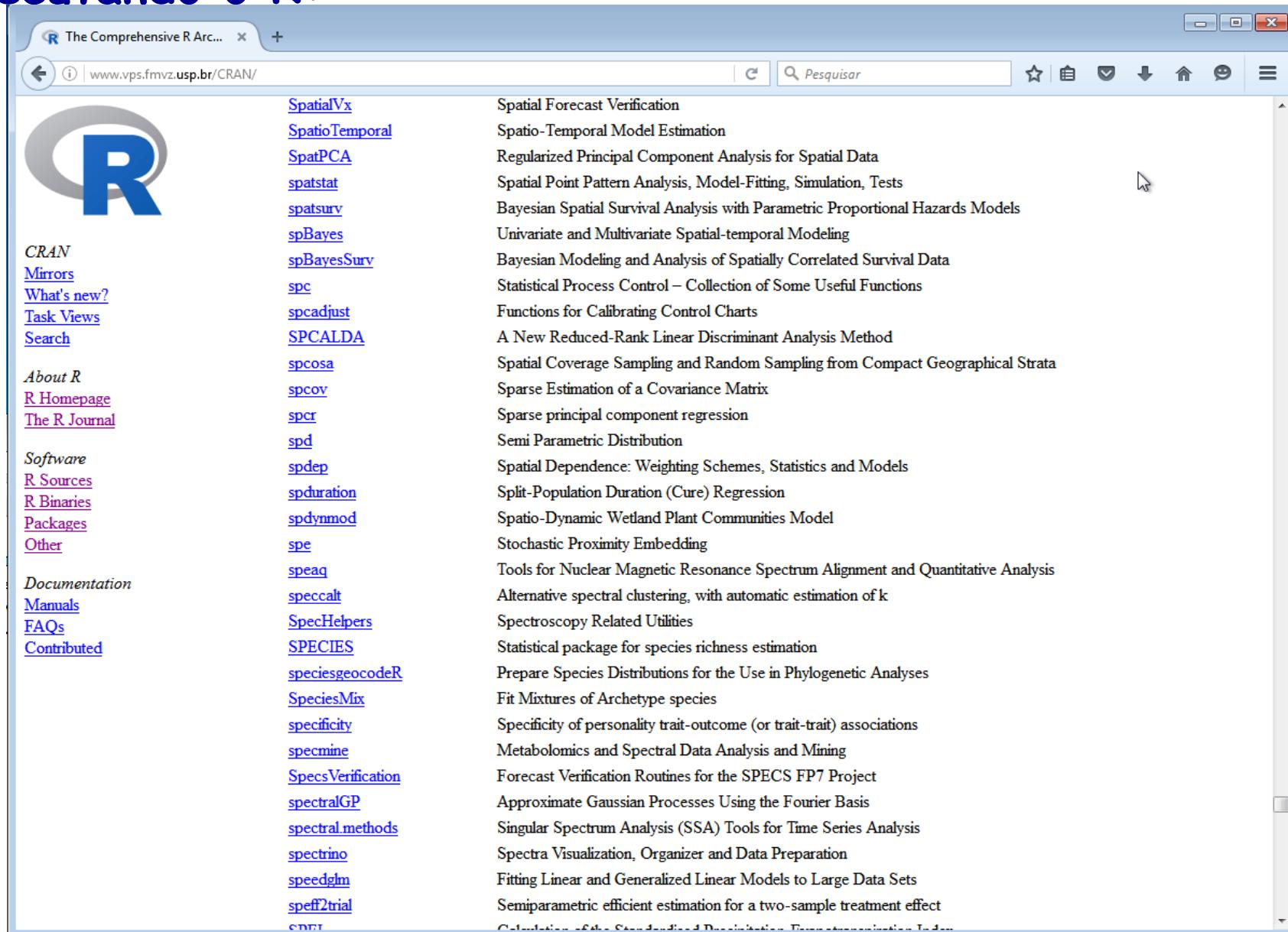


## Executando o R:



The screenshot shows a web browser window displaying the Comprehensive R Archive Network (CRAN) homepage. The URL in the address bar is [www.vps.fmvz.usp.br/CRAN/](http://www.vps.fmvz.usp.br/CRAN/). The page title is "Contributed Packages". On the left side, there is a sidebar with links for 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, and Contributed. The main content area starts with a large R logo and the heading "Available Packages". It states that there are currently 8137 available packages. There are two links: "Table of available packages, sorted by date of publication" and "Table of available packages, sorted by name". Below this is a section titled "Installation of Packages" with instructions on how to install packages from the repository. It mentions the manual [R Installation and Administration](#) for more details. The next section is "CRAN Task Views", which allows users to browse packages by topic and automatically install all packages for special areas of interest. It currently lists 33 views. A "Package Check Results" section follows, stating that all packages are tested regularly on machines running Debian GNU/Linux, Fedora, OS X, Solaris and Windows. The results are summarized in the [check summary](#), with additional details for Windows checking and building available in the [Windows check summary](#). The "Writing Your Own Packages" section describes the manual [Writing R Extensions](#) for contributing new packages. The "Repository Policies" section contains the manual [CRAN Repository Policy \[PDF\]](#). At the bottom, there is a "Related Directories" section with links to [Archive](#) (for previous versions), [Orphaned](#) (for packages with no maintainer), and [bin/windows/contrib](#) (for Windows binaries).

## Executando o R:



The screenshot shows a web browser window displaying the Comprehensive R Archive Network (CRAN) search results for packages starting with "Spatial". The URL in the address bar is [www.vps.fmvz.usp.br/CRAN/](http://www.vps.fmvz.usp.br/CRAN/). The left sidebar contains links for CRAN, Mirrors, What's new?, Task Views, Search, About R, R Homepage, The R Journal, Software, R Sources, R Binaries, Packages, and Other. The Documentation section includes links for Manuals, FAQs, and Contributed. The main content area lists packages and their descriptions:

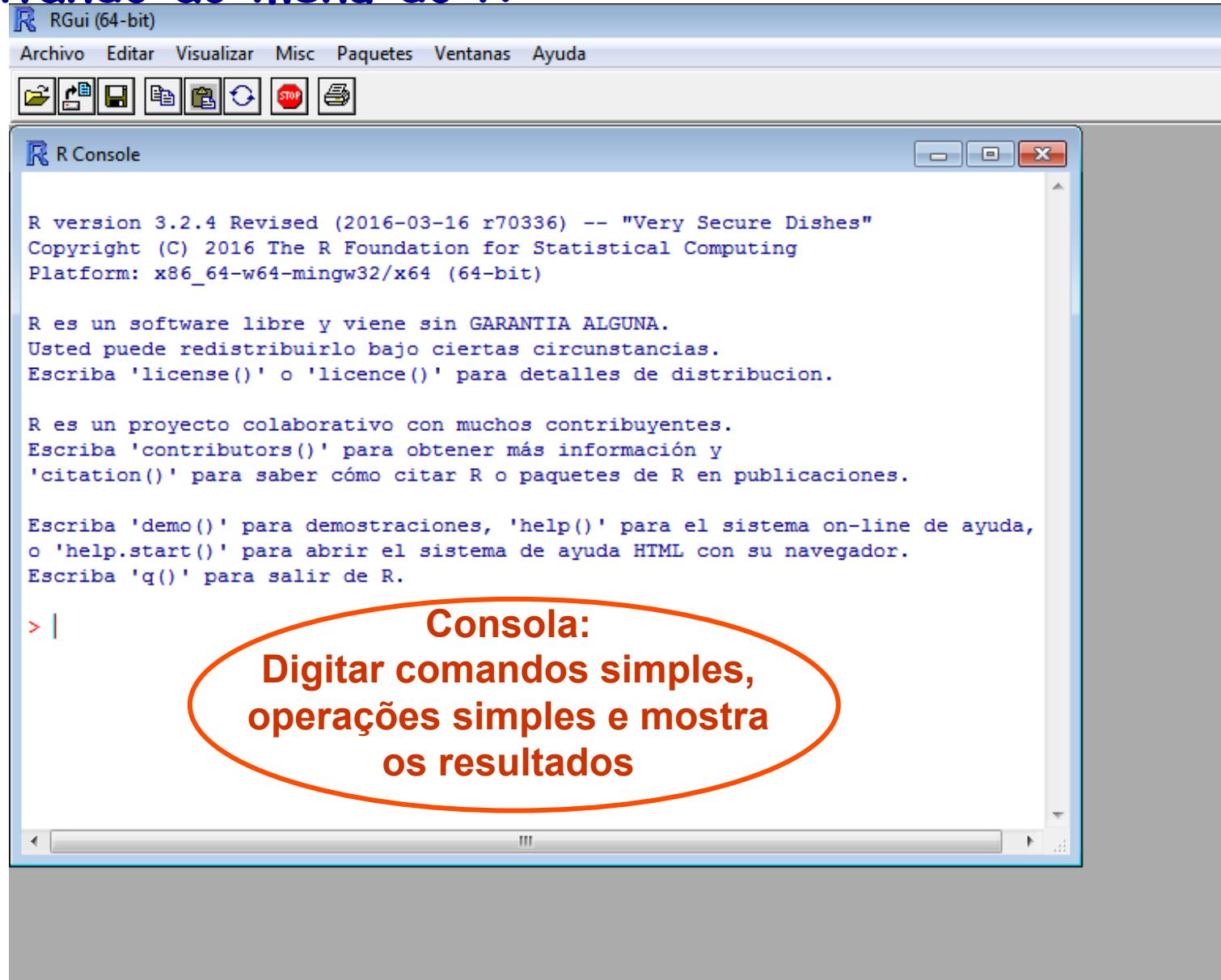
Package	Description
<a href="#">SpatialVx</a>	Spatial Forecast Verification
<a href="#">SpatioTemporal</a>	Spatio-Temporal Model Estimation
<a href="#">SpatPCA</a>	Regularized Principal Component Analysis for Spatial Data
<a href="#">spatstat</a>	Spatial Point Pattern Analysis, Model-Fitting, Simulation, Tests
<a href="#">spatsurv</a>	Bayesian Spatial Survival Analysis with Parametric Proportional Hazards Models
<a href="#">spBayes</a>	Univariate and Multivariate Spatial-temporal Modeling
<a href="#">spBayesSurv</a>	Bayesian Modeling and Analysis of Spatially Correlated Survival Data
<a href="#">spc</a>	Statistical Process Control – Collection of Some Useful Functions
<a href="#">spcadjust</a>	Functions for Calibrating Control Charts
<a href="#">SPCALDA</a>	A New Reduced-Rank Linear Discriminant Analysis Method
<a href="#">spcosa</a>	Spatial Coverage Sampling and Random Sampling from Compact Geographical Strata
<a href="#">spcov</a>	Sparse Estimation of a Covariance Matrix
<a href="#">spcr</a>	Sparse principal component regression
<a href="#">spd</a>	Semi Parametric Distribution
<a href="#">spdep</a>	Spatial Dependence: Weighting Schemes, Statistics and Models
<a href="#">spduration</a>	Split-Population Duration (Cure) Regression
<a href="#">spdynmod</a>	Spatio-Dynamic Wetland Plant Communities Model
<a href="#">spe</a>	Stochastic Proximity Embedding
<a href="#">speaq</a>	Tools for Nuclear Magnetic Resonance Spectrum Alignment and Quantitative Analysis
<a href="#">specallt</a>	Alternative spectral clustering, with automatic estimation of k
<a href="#">SpecHelpers</a>	Spectroscopy Related Utilities
<a href="#">SPECIES</a>	Statistical package for species richness estimation
<a href="#">speciesgeocodeR</a>	Prepare Species Distributions for the Use in Phylogenetic Analyses
<a href="#">SpeciesMix</a>	Fit Mixtures of Archetype species
<a href="#">specificity</a>	Specificity of personality trait-outcome (or trait-trait) associations
<a href="#">specmine</a>	Metabolomics and Spectral Data Analysis and Mining
<a href="#">SpecsVerification</a>	Forecast Verification Routines for the SPECS FP7 Project
<a href="#">spectralGP</a>	Approximate Gaussian Processes Using the Fourier Basis
<a href="#">spectral.methods</a>	Singular Spectrum Analysis (SSA) Tools for Time Series Analysis
<a href="#">spectrino</a>	Spectra Visualization, Organizer and Data Preparation
<a href="#">speedglm</a>	Fitting Linear and Generalized Linear Models to Large Data Sets
<a href="#">speff2trial</a>	Semiparametric efficient estimation for a two-sample treatment effect
<a href="#">spnnt</a>	Censored Latent Class Structural Equation Modeling

## Executando o R:

The screenshot shows a web browser window displaying the CRAN package page for 'spc'. The page title is 'spc: Statistical Process Control - Collection of Some Useful Functions'. It provides a brief description of the package, version information (0.5.3), dependencies (R ≥ 1.8.0), publication details (Published: 2016-02-08), author (Sven Knoth), maintainer (Sven Knoth <Sven.Knoth at gmx.de>), license (GPL-2), and URL (<http://v>). The page also lists compilation requirements (NeedsCompilation: yes), CRAN checks results, download links for Windows, OS X, and Linux, and reverse dependencies/suggests.

A Firefox download dialog box is overlaid on the page, titled 'Abrir "spc\_0.5.3.zip"'. It asks 'Você selecionou abrir:' and shows the file 'spc\_0.5.3.zip' with a compressed (zipped) folder icon. It provides the type ('Compressed (zipped) Folder (747 KB)') and source ('de: <http://www.vps.fmvz.usp.br>'). The dialog box then asks 'O que o Firefox deve fazer?' with two options: 'Abrir com o: Explorador de Windows (aplicativo padrão)' (radio button selected) and 'Download' (radio button). There is also a checkbox 'Memorizar a decisão para este tipo de arquivo'. At the bottom are 'OK' and 'Cancelar' buttons.

## Voltando ao menu do R:



## Instalando o RStudio:

A screenshot of a Google search results page for "r studio". The search bar at the top shows "r studio". Below the search bar, there are tabs for "Todas", "Vídeos", "Aplicativos", "Imagens", "Shopping", "Mais ▾", and "Ferramentas de pesquisa". The search results section starts with a summary: "Aproximadamente 30.500.000 resultados (0,20 segundos)". The first result is highlighted with a red oval and has a large orange arrow pointing to it from the right. The result title is "RStudio – Open source and enterprise-ready professional ..." and the URL is "https://www.rstudio.com/". Below the title, there is a snippet: "A powerful and productive user interface for R. It's free and open source, and works great on Windows, Mac, and Linux." Other results listed include "Download RStudio – RStudio", "RStudio – RStudio", "R-Studio download - Baixaki", and "Como recuperar dados perdidos com o R-STUDIO+SERIAL ...".

## Instalando o RStudio:

The screenshot shows the RStudio website homepage. At the top, there's a navigation bar with links for Products, Resources, Pricing, About Us, and Blog, along with a search icon. Below the navigation, there's a testimonial from Marina Theodosiou, Risk Analytics Manager at Funding Circle, featuring a circular profile picture of her and a quote: "The establishment of interactive feedback loops through Shiny allows us to continually optimize our decision processes." A button below the quote says "Click to download the full story". There are five small circular icons below the testimonial. The main content area has three columns: the first column is titled "Powerful IDE for R" with a lightning bolt icon; the second column is titled "R Packages" with a gift icon; and the third column is titled "Bring R to the web" with a cloud icon. Each column contains descriptive text about its respective feature.

"The establishment of interactive feedback loops through Shiny allows us to continually optimize our decision processes."

- Marina Theodosiou, Risk Analytics Manager at Funding Circle

Click to download the full story

○○○○○

**Powerful IDE for R**

RStudio IDE is a powerful and productive user interface for R. It's free and open source, and works great on Windows, Mac, and Linux.

**R Packages**

Our developers and expert trainers are the authors of several popular R packages, including ggplot2, plyr, lubridate, and others.

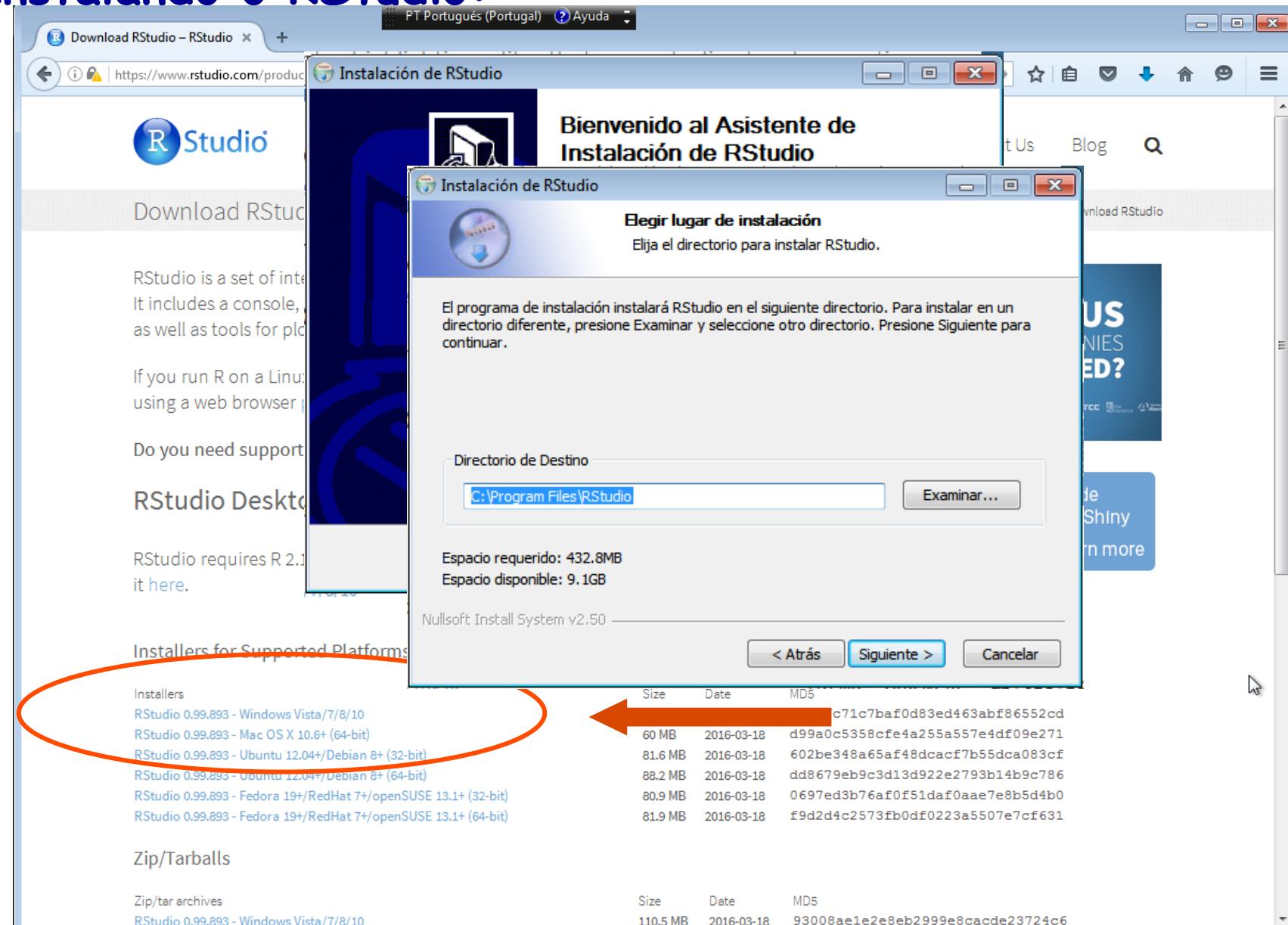
**Bring R to the web**

Shiny is an elegant and powerful web framework for building interactive reports and visualizations using R — with or without web development skills.

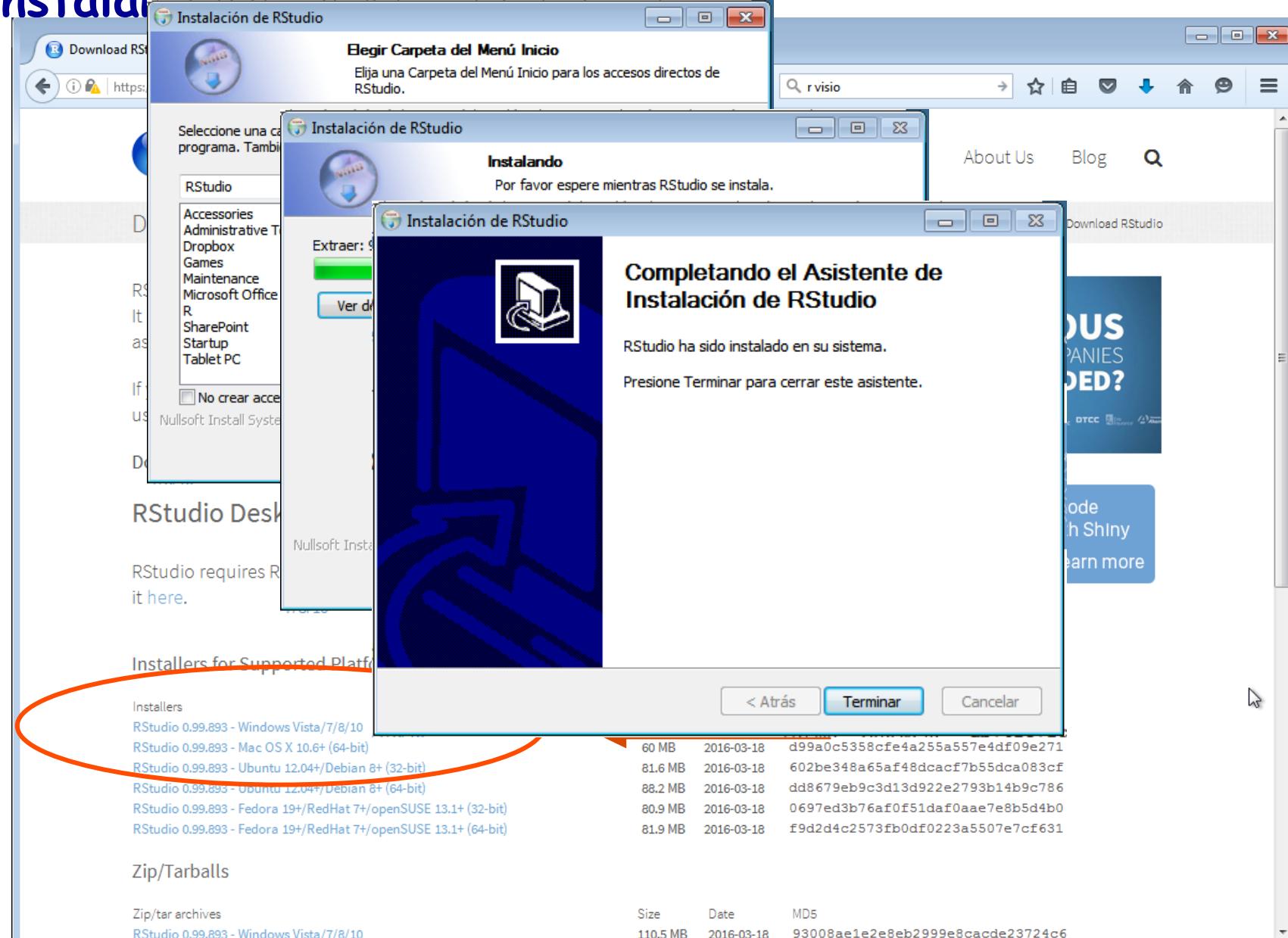
## Instalando o RStudio:

The screenshot shows the RStudio website homepage. At the top, there's a navigation bar with links for Products, Resources, Pricing, About Us, Blog, and a search icon. Below the navigation, the text "Take control of your R code" is displayed, followed by a paragraph about RStudio being an IDE for R. A "CLICK HERE TO SEE MORE FEATURES" button is located below this text. On the left, there are two main sections: "Desktop" (represented by a user icon) and "Server" (represented by a group of users icon). The "Desktop" section includes the text "Run RStudio on your desktop" and a link "RStudio > Desktop". The "Server" section includes the text "Centralize access and computation" and a link "RStudio Server >". A red circle highlights the "RStudio > Desktop" link, and a red arrow points from the "Server" section towards it.

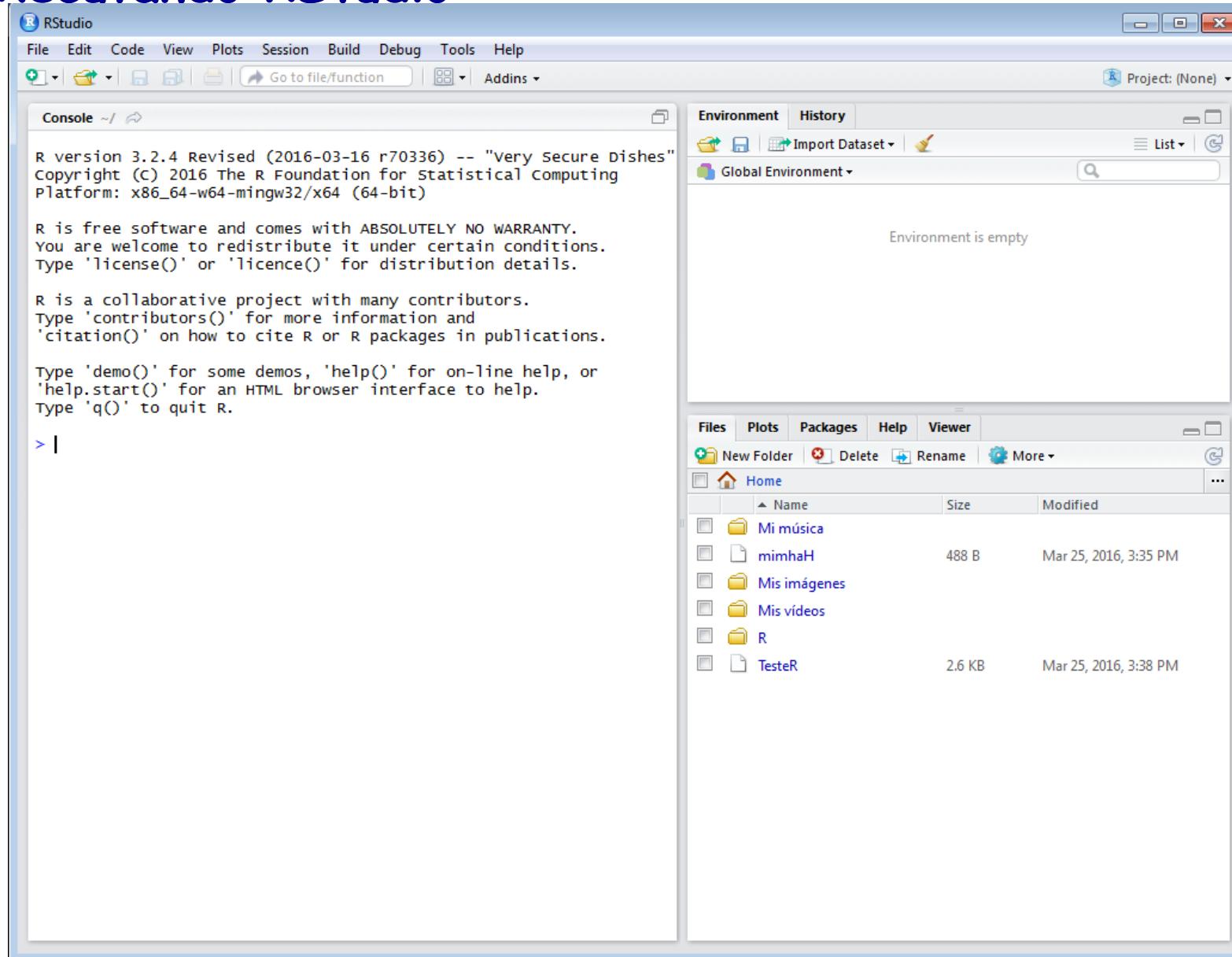
## Instalando o RStudio:



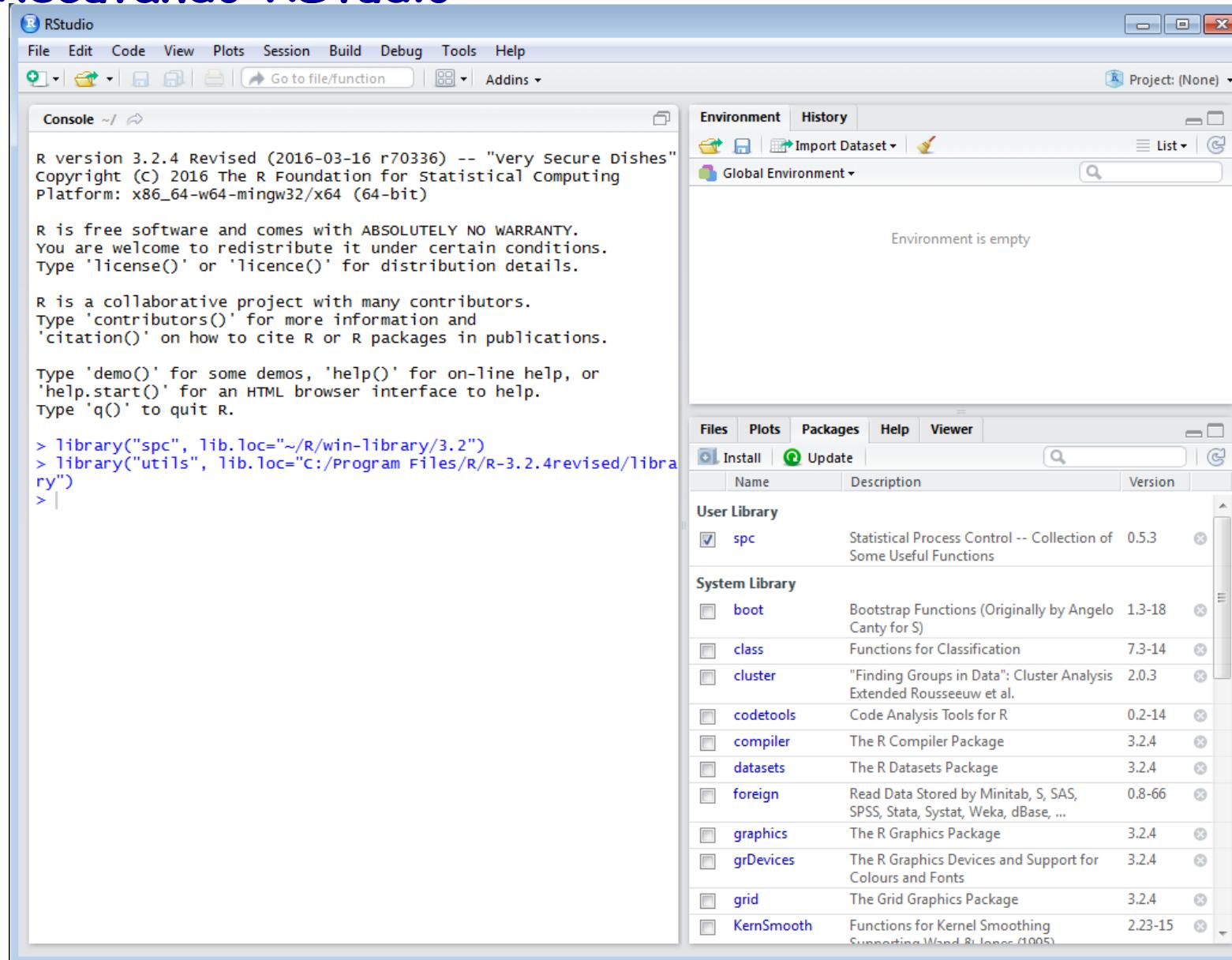
## Instalando o RStudio:



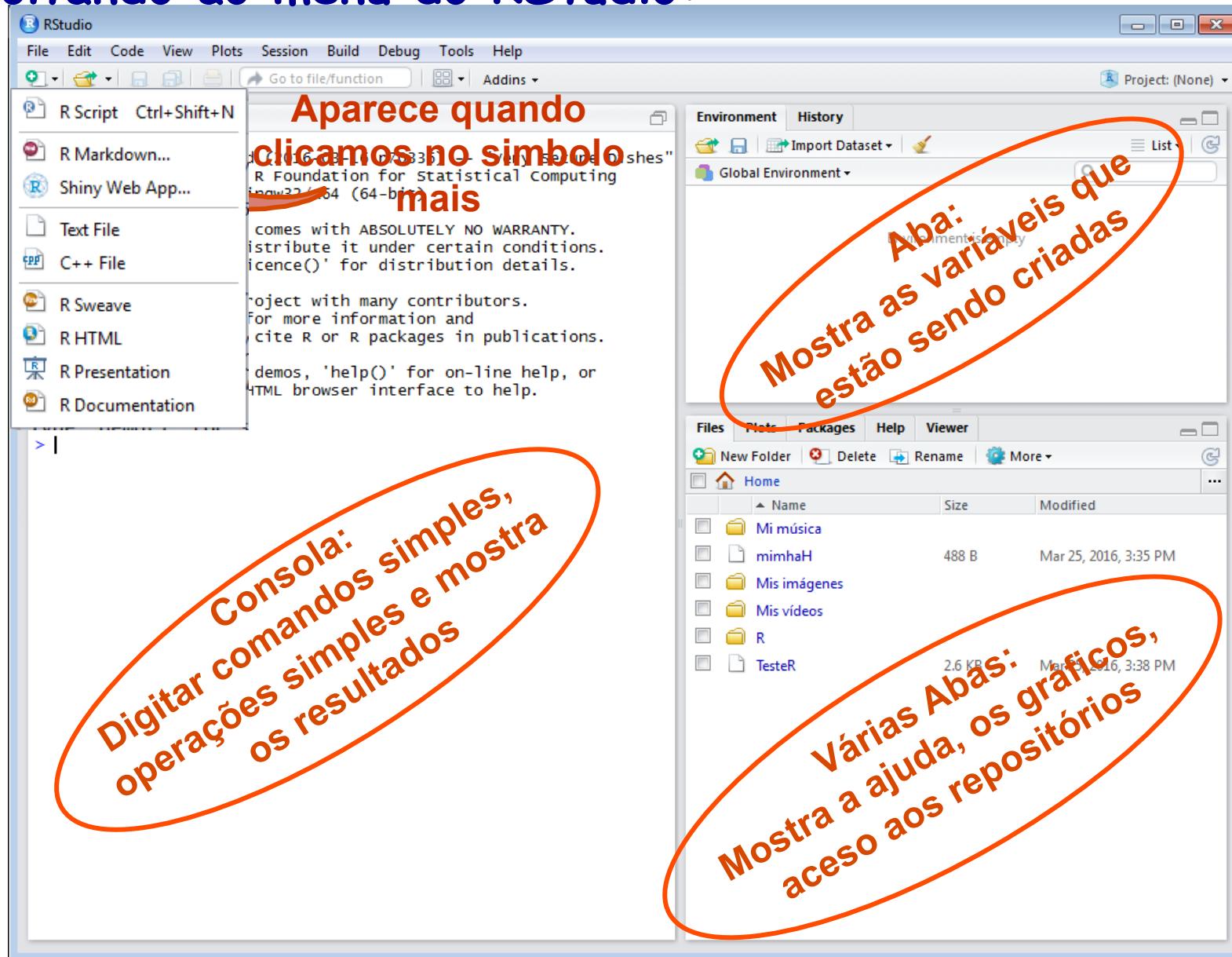
## Executando RStudio:



## Executando RStudio:



## Voltando ao menu do RStudio:



# Tema 03b: Software R

## Voltando ao menu do RStudio:

