Installation Instructions: R and RStudio

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Overview

This document walks you through installing the required software on your laptop before the first lecture. We will use the statistical programming environment R (R Core Team 2018), together with the integrated development environment (IDE) RStudio Desktop (RStudio Team 2018), in this course. Both of these are available for free from their respective websites. Additionally, there are some add-on packages that will need to be installed on your system.

You have to install both R and RStudio before the first class. Preferably, check that you have the latest versions of both of these. Below you will find instructions on installing these components. Please make sure you go through these steps before attending the first class. In case you are not able to complete the steps below successfully, please come to the first class 15 minutes earlier so that we can try to sort it out.

Existing Installations

Skip this section if this is the first time you are installing R.

If you have already installed R and/or RStudio earlier, it is better to upgrade to the latest versions of all software mentioned here. One caveat with upgrading your version of R is that upgrading to the latest major version may require you to reinstall your packages. For example, when upgrading from R 3.4.4 to R 3.5.0 you will need to reinstall add-on packages, but not when upgrading from R 3.4.3 to R 3.4.4. If you have (say) the second latest version of R and is currently busy using it for an important project, it may be best to wait until you have finished your project.

There are generally no downsides to updating RStudio.

At the time of writing, the latest versions are R 3.5.1 (nicknamed "Feather Spray") and version 1.1.456 of the RStudio Desktop IDE. If you have a much older version of R installed, you may have issues installing new packages since these often require the latest version of R. We are going to be installing several add-on packages during this course, and there will not be time in class to troubleshoot installation issues. If you want to be sure that you won't fall behind because of such issues, take the time to make sure you have the latest versions.

In case you are not able to obtain the latest versions, for example because you are not the administrator of your laptop, you are advised to check whether you can install the required add-on R packages before coming to each class. For troubleshooting, contact your system administrator timeously, and see the section *Administrative Rights* below.

You can update the packages you have already installed using the 'Update' button under RStudio's 'Packages' tab.

Quick Version

If you don't want to read the detailed installation instructions that follow, install R and RStudio Desktop now directly using:

- https://cloud.r-project.org/
- https://www.rstudio.com/products/rstudio/download/

Thereafter, continue from the section *Installing Packages* to verify that you are ready for class.

Installing R

Open the R homepage by browsing to https://www.r-project.org/. You should see the web page resembling Figure 1:

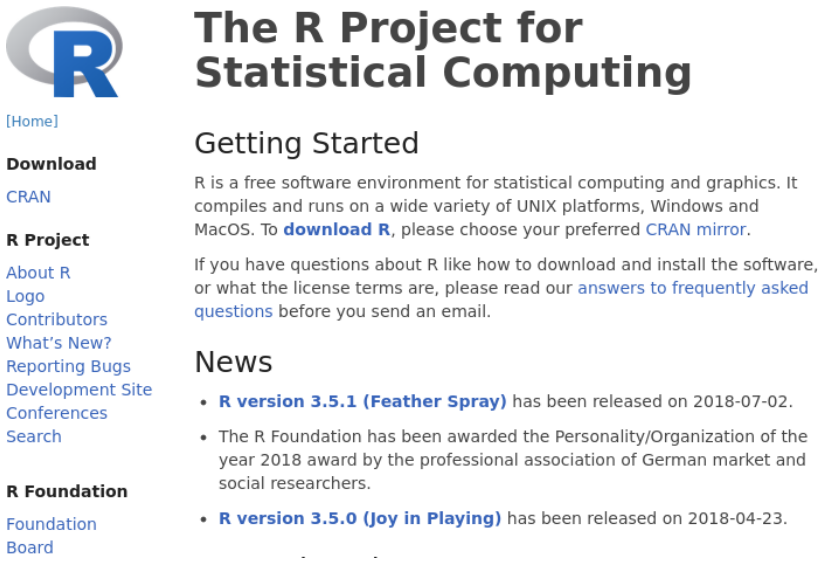
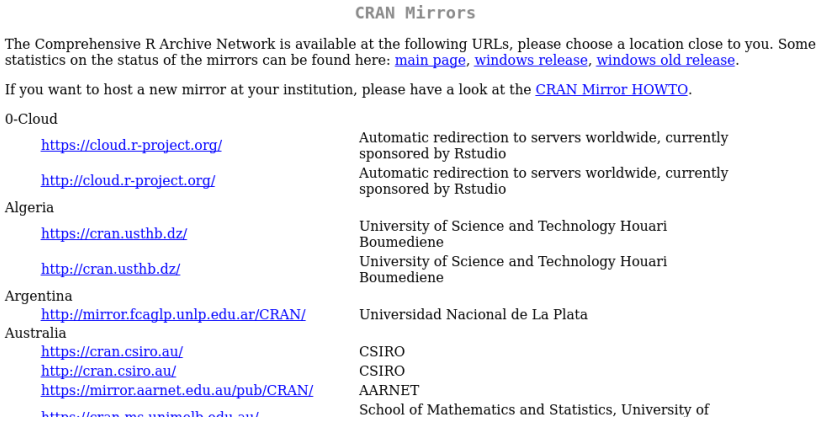


Figure 1: The R Project home page.

To download R, click on the 'CRAN' link on the top left of the sidebar (Figure 1) to access the Comprehensive R Archive Network (CRAN), which is how R and the majority of its packages are distributed. You may see the webpage page as in Figure 2 asking you to choose a CRAN mirror, which is just a server containing a copy of CRAN.

Simply click the first link under 0-Cloud (https://cloud.r-project.org/) as in Figure 2:



CRAN Mirrors

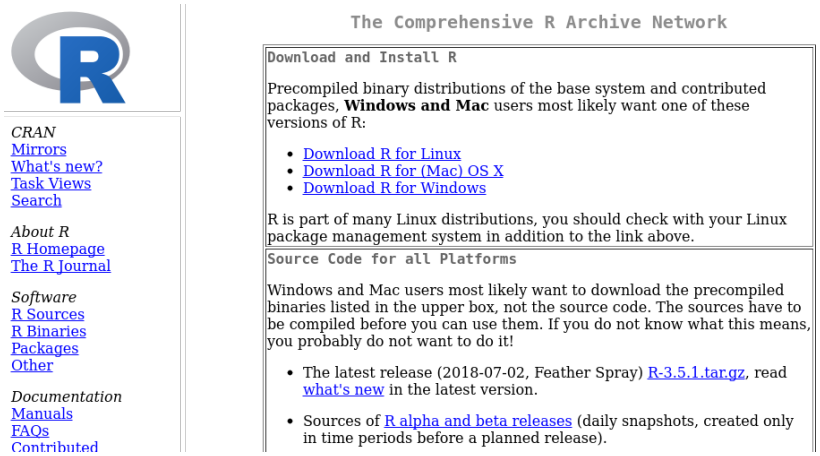
The Comprehensive R Archive Network is available at the following URLs, please choose a location close to you. Some statistics on the status of the mirrors can be found here: main page, windows release, windows old release.

If you want to host a new mirror at your institution, please have a look at the CRAN Mirror HOWTO.

0-Cloud	
https://cloud.r-project.org/	Automatic redirection to servers worldwide, currently sponsored by Rstudio
http://cloud.r-project.org/	Automatic redirection to servers worldwide, currently sponsored by Rstudio
Algeria	
https://cran.usthb.dz/	University of Science and Technology Houari Boumediene
http://cran.usthb.dz/	University of Science and Technology Houari Boumediene
Argentina	
http://mirror.fcaglp.unlp.edu.ar/CRAN/	Universidad Nacional de La Plata
Australia	
https://cran.csiro.au/	CSIRO
http://cran.csiro.au/	CSIRO
https://mirror.aarnet.edu.au/pub/CRAN/	AARNET
https://cran.ms.unimelb.edu.au/	School of Mathematics and Statistics, University of

Figure 2: Webpage listing all CRAN mirrors.

This leads you to the download page for the R installer, displayed in Figure 3. Choose the download link for your respective platform (either Linux, Mac OS X or Windows):



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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!

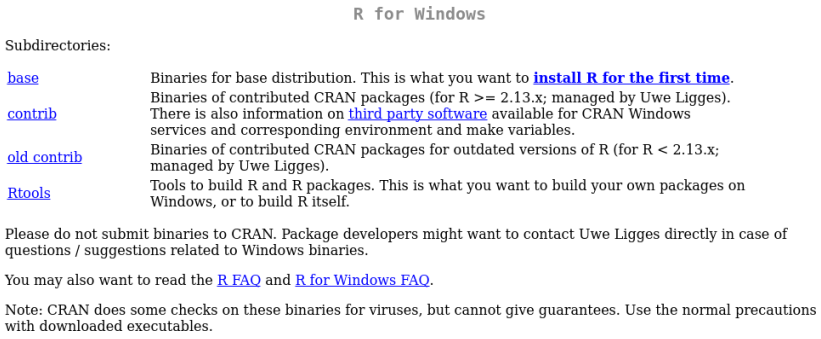
- The latest release (2018-07-02, Feather Spray) R-3.5.1.tar.gz, read what's new in the latest version.
- Sources of R alpha and beta releases (daily snapshots, created only in time periods before a planned release).

Figure 3: The main download page on CRAN.

Click on the appropriate download link for your operating system. Separate instructions for the different operating systems follow below.

Windows

After clicking on the 'Download R for Windows' link, you will see the page in Figure 4:



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.

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.

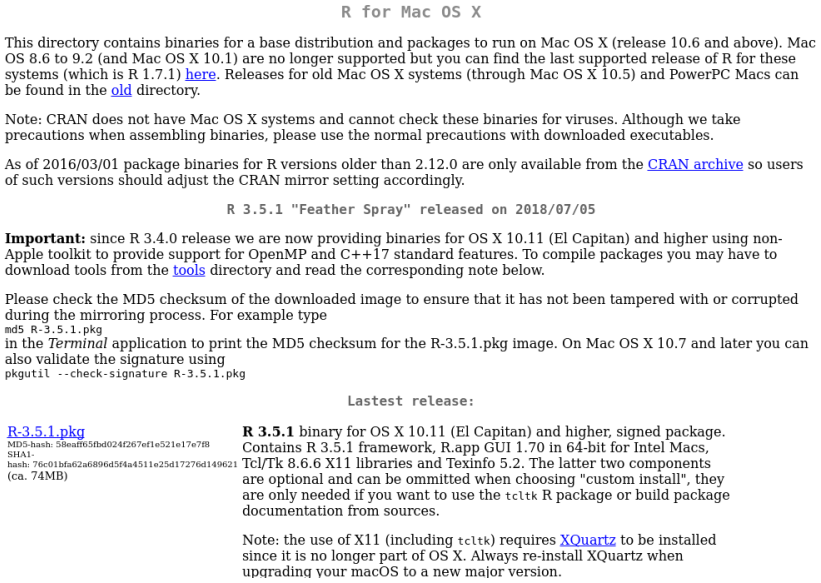
Note: CRAN does some checks on these binaries for viruses, but cannot give guarantees. Use the normal precautions with downloaded executables.

Figure 4: The Windows download page on CRAN.

Click on the 'base' (or 'install R for the first time') link, download the '.exe' Windows installer and install R as you would normally install a Windows program (the installation defaults will suffice). Once the process has completed, proceed to installing RStudio (see below).

Mac OS X

On Mac OS X, follow the link 'Download R for (Mac) OS X'. You will land on the page listed in Figure 5:



R for Mac OS X

This directory contains binaries for a base distribution and packages to run on Mac OS X (release 10.6 and above). Mac OS 8.6 to 9.2 (and Mac OS X 10.1) are no longer supported but you can find the last supported release of R for these systems (which is R 1.7.1) here. Releases for old Mac OS X systems (through Mac OS X 10.5) and PowerPC Macs can be found in the old directory.

Note: CRAN does not have Mac OS X systems and cannot check these binaries for viruses. Although we take precautions when assembling binaries, please use the normal precautions with downloaded executables.

As of 2016/03/01 package binaries for R versions older than 2.12.0 are only available from the CRAN archive so users of such versions should adjust the CRAN mirror setting accordingly.

R 3.5.1 "Feather Spray" released on 2018/07/05

Important: since R 3.4.0 release we are now providing binaries for OS X 10.11 (El Capitan) and higher using non-Apple toolkit to provide support for OpenMP and C++17 standard features. To compile packages you may have to download tools from the tools directory and read the corresponding note below.

Please check the MD5 checksum of the downloaded image to ensure that it has not been tampered with or corrupted during the mirroring process. For example type
`md5 R-3.5.1.pkg`
in the *Terminal* application to print the MD5 checksum for the R-3.5.1.pkg image. On Mac OS X 10.7 and later you can also validate the signature using
`pkgutil --check-signature R-3.5.1.pkg`

Lastest release:

R-3.5.1.pkg
MD5-hash: 58eaff65fbd024f267ef1e521e17e7f8
SHA1-hash: 76c01bfa62a6896d5f4a4511e25d17276d149621
(ca. 74MB)

R 3.5.1 binary for OS X 10.11 (El Capitan) and higher, signed package. Contains R 3.5.1 framework, R.app GUI 1.70 in 64-bit for Intel Macs, Tcl/Tk 8.6.6 X11 libraries and Texinfo 5.2. The latter two components are optional and can be ommitted when choosing "custom install", they are only needed if you want to use the `tcltk` R package or build package documentation from sources.

Note: the use of X11 (including `tcltk`) requires XQuartz to be installed since it is no longer part of OS X. Always re-install XQuartz when upgrading your macOS to a new major version.

Figure 5: The Mac OS X download page on CRAN.

Download the '.pkg' binary file and install it by double-clicking on it and working through the prompts as usual. Once the process has completed, proceed to installing RStudio (see below).

Linux

If you are running Linux, click on the 'Download R for Linux' link. You will land on the page shown in Figure 6:

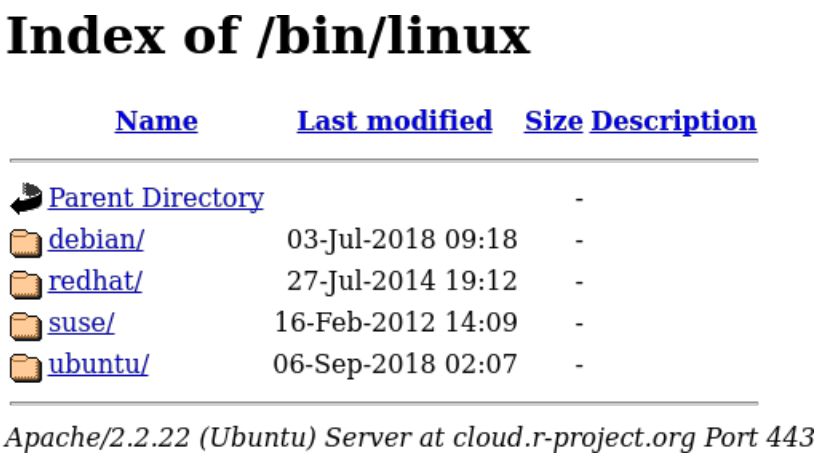


Figure 6: The Linux download page on CRAN.

Pick the appropriate Linux flavour and proceed accordingly. You should be able to proceed on your own from here using the instructions provided on the respective web pages. Once the process has completed, proceed to installing RStudio (see below).

Installing RStudio Desktop

RStudio is an IDE that integrates with R to provide a more user-friendly interface and additional functionality. To install RStudio Desktop on your laptop for free, visit https://www.rstudio.com. You should see the page displayed in Figure 7:

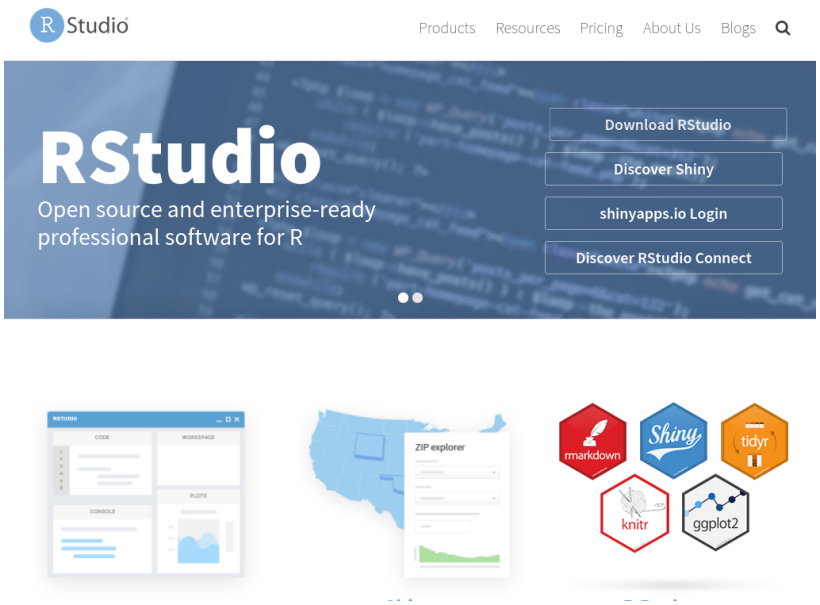
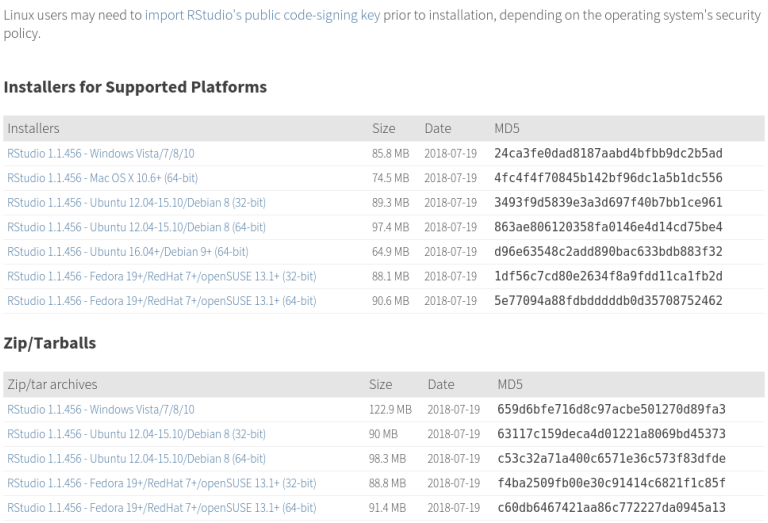


Figure 7: The RStudio home page.

Click on 'Download RStudio' and scroll down until you see the available installers for RStudio Desktop, as in Figure 8:



Linux users may need to import RStudio's public code-signing key prior to installation, depending on the operating system's security policy.

Installers for Supported Platforms

Installers	Size	Date	MD5
RStudio 1.1.456 - Windows Vista/7/8/10	85.8 MB	2018-07-19	24ca3fe0dad8187aabd4bfbb9dc2b5ad
RStudio 1.1.456 - Mac OS X 10.6+ (64-bit)	74.5 MB	2018-07-19	4fc4f4f70845b142bf96dc1a5b1dc556
RStudio 1.1.456 - Ubuntu 12.04-15.10/Debian 8 (32-bit)	89.3 MB	2018-07-19	3493f9d5839e3a3d697f40b7bb1ce961
RStudio 1.1.456 - Ubuntu 12.04-15.10/Debian 8 (64-bit)	97.4 MB	2018-07-19	863ae806120358fa0146e4d14cd75be4
RStudio 1.1.456 - Ubuntu 16.04+/Debian 9+ (64-bit)	64.9 MB	2018-07-19	d96e63548c2add890bac633bdb883f32
RStudio 1.1.456 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	88.1 MB	2018-07-19	1df56c7cd80e2634f8a9fdd11ca1fb2d
RStudio 1.1.456 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	90.6 MB	2018-07-19	5e77094a88fdbddddddb0d35708752462

Zip/Tarballs

Zip/tar archives	Size	Date	MD5
RStudio 1.1.456 - Windows Vista/7/8/10	122.9 MB	2018-07-19	659d6bfe716d8c97acbe501270d89fa3
RStudio 1.1.456 - Ubuntu 12.04-15.10/Debian 8 (32-bit)	90 MB	2018-07-19	63117c159deca4d01221a8069bd45373
RStudio 1.1.456 - Ubuntu 12.04-15.10/Debian 8 (64-bit)	98.3 MB	2018-07-19	c53c32a71a400c6571e36c573f83dfde
RStudio 1.1.456 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (32-bit)	88.8 MB	2018-07-19	f4ba2509fb00e30c91414c6821f1c85f
RStudio 1.1.456 - Fedora 19+/RedHat 7+/openSUSE 13.1+ (64-bit)	91.4 MB	2018-07-19	c60db6467421aa86c772227da0945a13

Figure 8: The RStudio download page after scrolling down.

Choose the correct installer link for your operating system from the top list (most modern computers are 64-bit), and save the installer to disk. Open this installer and follow the prompts to complete the installation of RStudio Desktop.

Once your installation has finished, you can open RStudio as you would any other application. In the console pane on the left, next to the '>' (shown here but not typed), type the following and hit Enter to see that

everything works:

```
> cat("Hello, world!")
```

Your view should look something like that shown in Figure 9 (there will be small unimportant differences depending on your platform and R version). You have just executed your first R command!

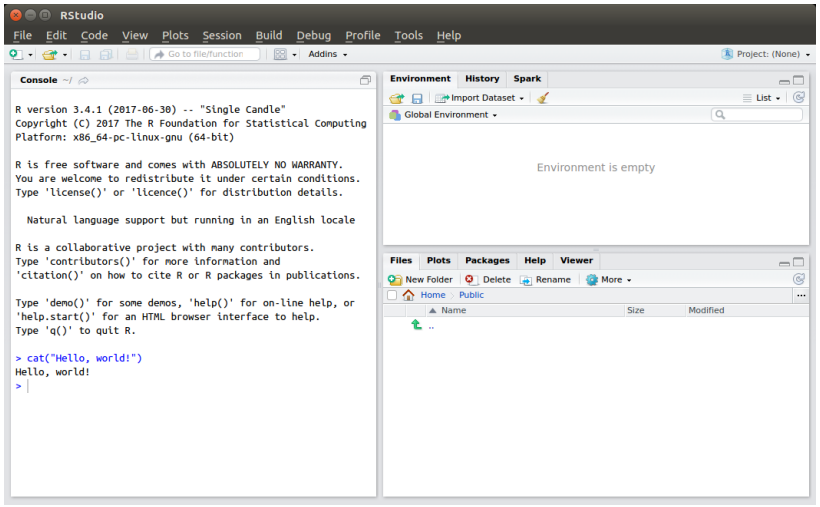


Figure 9: A typical RStudio window after executing the code from the text.

Installing Packages

R packages are collections of code that extend the capabilities of the standard R installation. They form a very important part of the R ecosystem, and we will make use of extension packages throughout this course. Packages are typically installed from CRAN by default (which requires an internet connection), but you can also install packages from other sources (local files, GitHub, and so forth).

To verify that you are able to install packages when required, we will install a popular collection of packages known as the **tidyverse**. Proceed by selecting the 'Packages' tab in the bottom right pane in RStudio, and click on the 'Install' button. At the prompt, type 'tidyverse' as in Figure 10 and click 'Install'.

The first time you install a package, you may be asked whether you want to compile the packages from its sources or not. You are advised **not** to compile packages upon installation unless you have a good reason to do so. In software terms, using the binary (pre-compiled) versions are advised. You may also encounter a prompt asking whether you would like to create a personal library (folder / directory) for installing the packages in. You should click 'Yes' to proceed.

Once you have started installing the packages, you should see several lines of output in your console flashing by as the packages are installed. When the installation has finished, you will see that the console again displays the command prompt '>'.

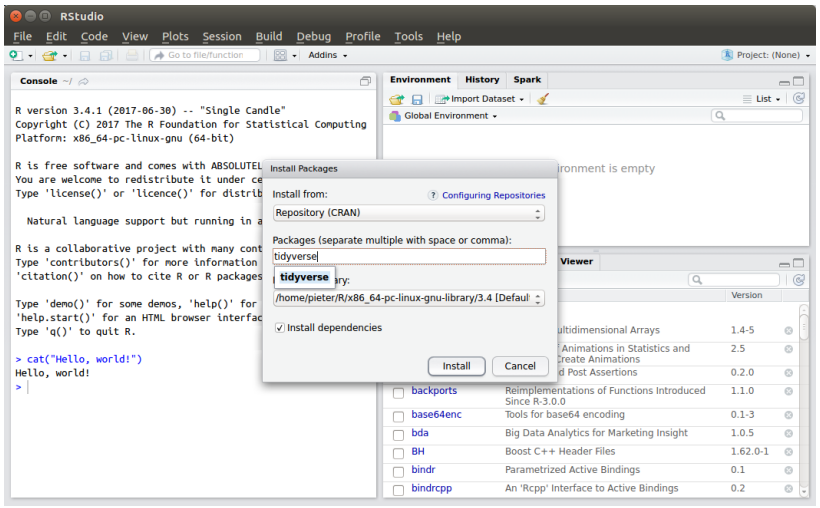


Figure 10: Installing the **tidyverse** collection of packages.

To verify that the packages have been installed successfully, type the following code in the console next to the prompt, and hit Enter.

```
> library("tidyverse")
```

You should see output similar to that in Figure 11 (your exact output may differ depending on your operating system and software versions). That is it: The **tidyverse** packages have been successfully installed!

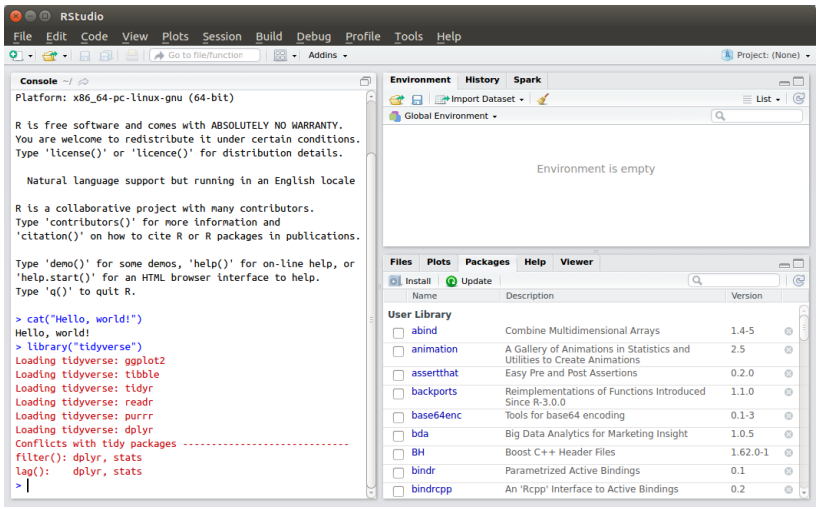


Figure 11: RStudio after loading the **tidyverse** collection of packages.

Installing from Local Files

It is also possible to install packages from local archive files. To do that, select 'Package Archive File' in the 'Install from:' box in the RStudio window, browse to the required file, and click 'Install' – see Figure 12. The archive file will have a '.zip' extension on Windows, '.tgz' on Mac OS X, and '.tar.gz' on Linux. You only need

to use the single correct archive file to install the package on your computer, and you should **not** extract (unzip) the archive file before following the installation procedure outlined in Figure 12.

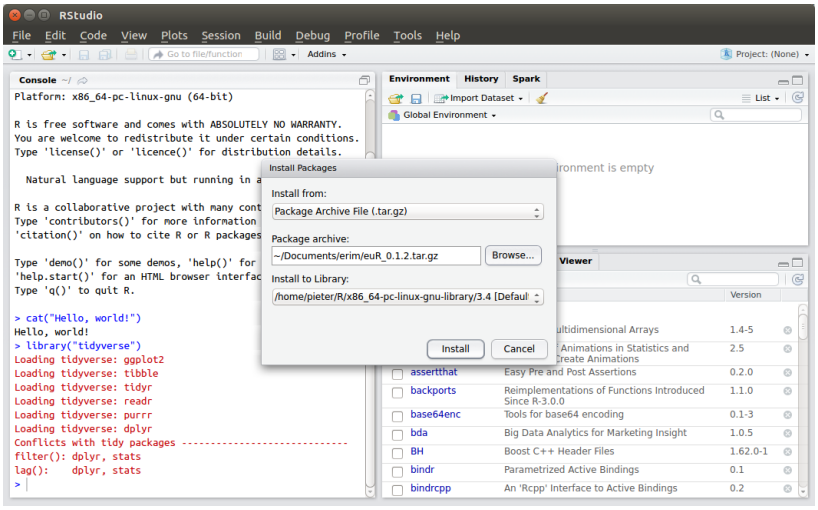


Figure 12: Installing packages from local archive files using RStudio.

When installing from a local archive file, all the packages that the new package depends on must already be installed on your system. This means that you may need to install several other packages before you can install such a package. Therefore, you should only install packages in this manner which we have supplied to you (if any) in this format.

Downloading Files Through a Browser

Note that some browsers (Safari, Chrome, ...) will open and resave files when you click on them for download without you being aware of it. This is not ideal, since the file may be changed in the process. It is advisable to always download files by right-clicking and selecting "Save link as" instead of simply clicking on them. This is to avoid confusing errors that can result on some computers. It applies to files downloaded from systems such as Canvas or Blackboard, including package source code and CSV data files.

Administrative Rights

To install packages, you must have administrative rights allowing you to make changes to your computer's file system. If you are using a computer you own, that is almost certainly the case, although on some Windows systems R must be 'Run as Administrator' when installing packages. In case your university or company issued the computer to you, you might not have the rights needed to install packages, or the default settings may not work. This may require you to customize the location to which packages are installed the first time that you install a package. If the package installation method above fails, and you cannot resolve it yourself or with the help of a system administrator, please come to class 15 minutes earlier so that we can help you out, if indeed it is possible.

One thing to try would be to explicitly state where you want to install the package on the file system. This can be done when installing the package from the command line, as in executing the following code from the R console in RStudio:

```
> install.packages("tidyverse", lib = "/path/to/directory")
```

Here `/path/to/directory` must be replaced by the path of a location on your file system where you are allowed to make changes (such as to your Documents directory). Always use `/` and not `\`, especially on Windows.

References

R Core Team (2018). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

RStudio Team (2018). *RStudio: Integrated Development for R*. RStudio, Inc., Boston, MA URL http://www.rstudio.com/.