Data I/O, Part 1

Data Wrangling in R

Explaining output on slides

In slides, a command (we'll also call them code or a code chunk) will look like this

```
print("I'm code")
```

```
[1] "I'm code"
```

And then directly after it, will be the output of the code.
So `print("I'm code")` is the code chunk and [1] "I'm code" is the output.

These slides were made in R using `knitr` and `R Markdown` (covered later today when we discuss reproducible research)

Data Input

- ‘Reading in’ data is the first step of any real project/analysis
- R can read almost any file format, especially via add-on packages
- We are going to focus on simple delimited files first
    - tab delimited (e.g. ‘.txt’)
    - comma separated (e.g. ‘.csv’)
    - Microsoft excel (e.g. ‘.xlsx’)

Data Input

UFO Sightings via Kaggle.com: “Reports of unidentified flying object reports in the last century”.

“There are two versions of this dataset: scrubbed and complete. The complete data includes entries where the location of the sighting was not found or blank (0.8146%) or have an erroneous or blank time (8.0237%). Since the reports date back to the 20th century, some older data might be obscured. Data contains city, state, time, description, and duration of each sighting.”

https://www.kaggle.com/NUFORC/ufo-sightings

Data Input

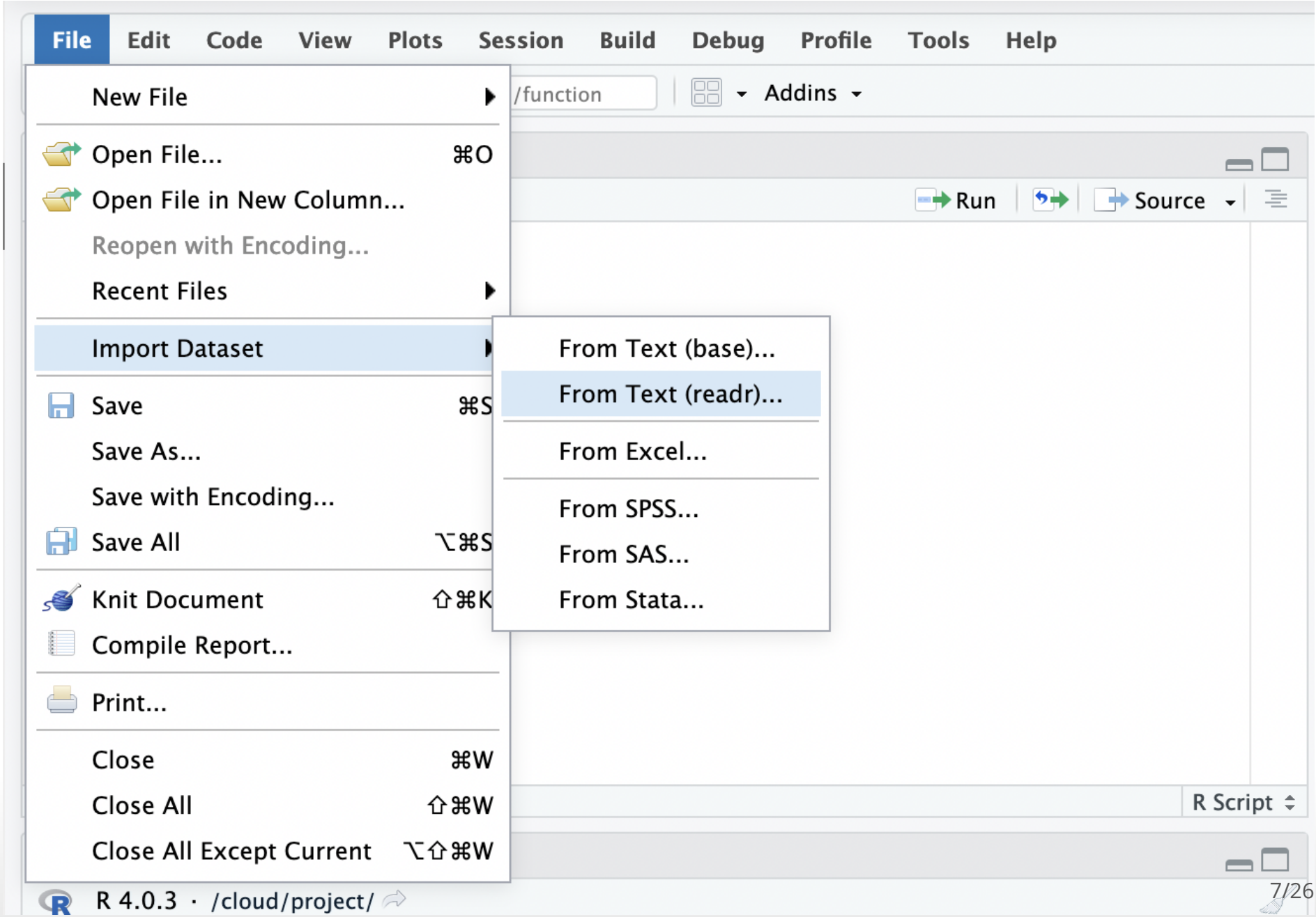
- Download data from http://sisbid.github.io/Data-Wrangling/data/ufo/ufo_data_complete.csv.gz
- Upload the data to RStudio Cloud

Data Input

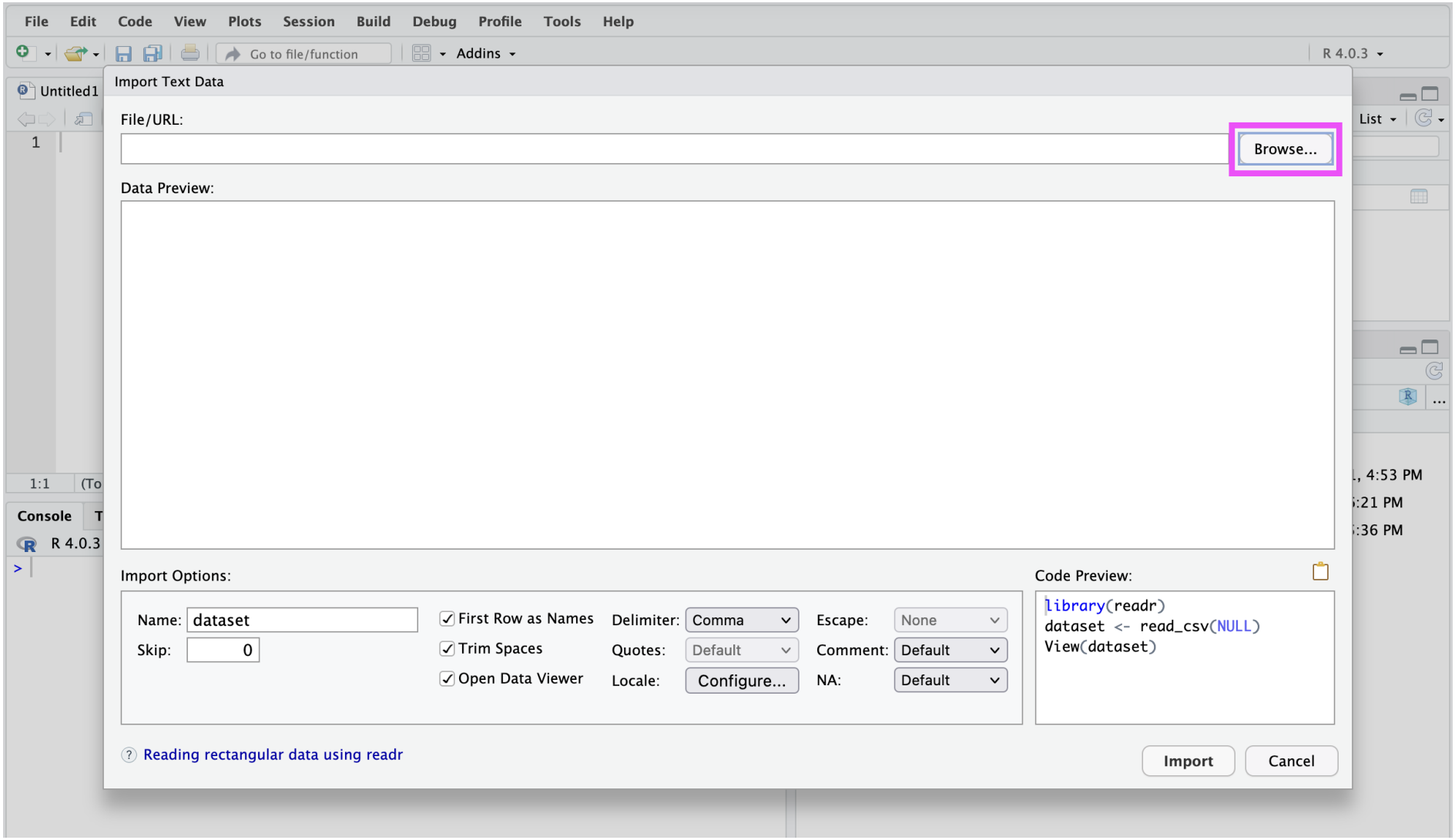
Easy way: import text datasets using the “File –> Import Dataset –> From Text (readr)” command. Selecting this will bring up a new screen that lets you specify the formatting of your text file.

Going through this process enters the corresponding R commands in the console (you can copy these for later!)

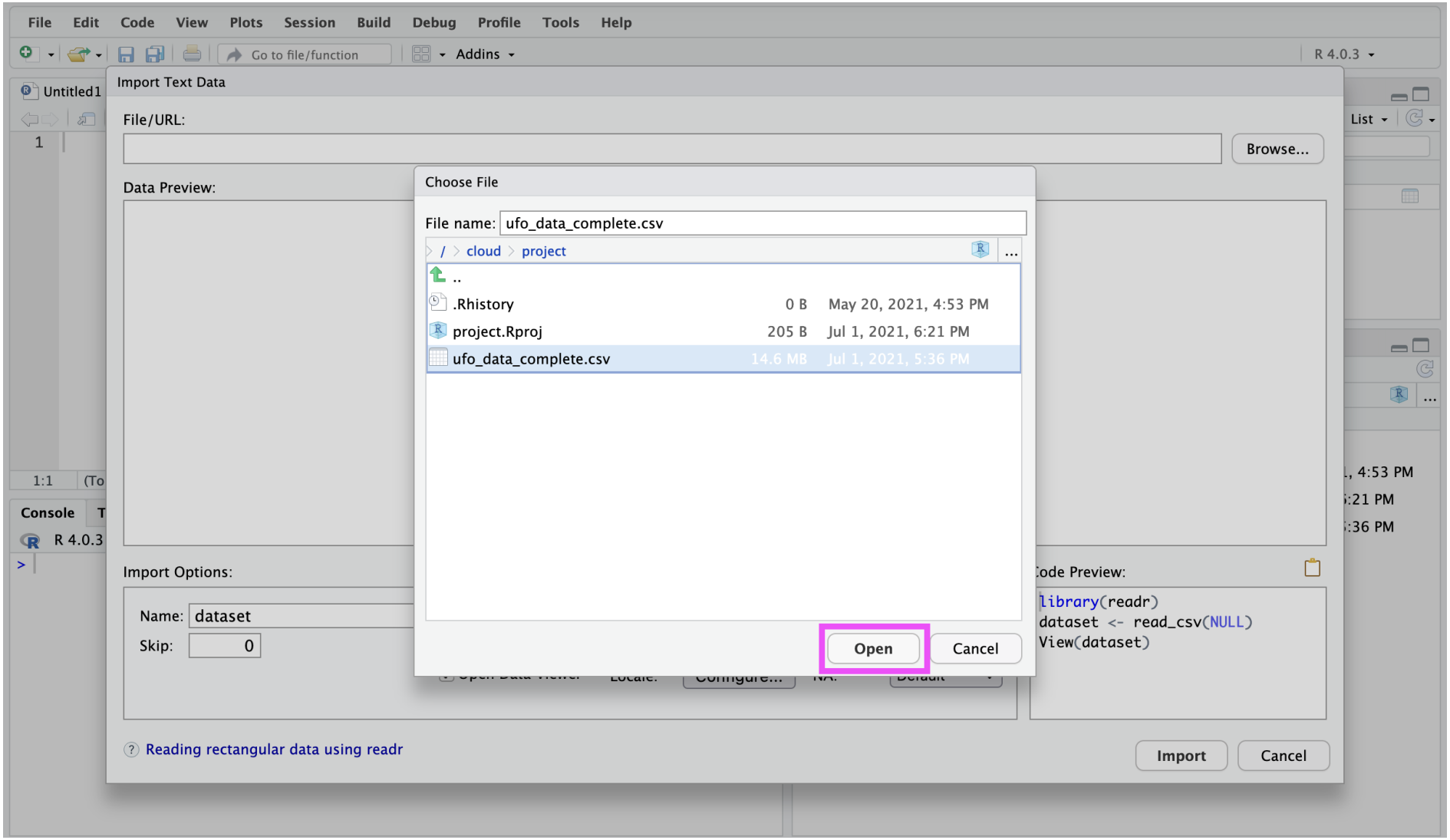
Data Input


File
Edit
Code
View
Plots
Session
Build
Debug
Profile
Tools
Help
New File
Open File... ⌘O
Open File in New Column...
Reopen with Encoding...
Recent Files
Import Dataset
Save ⌘S
Save As...
Save with Encoding...
Save All ⌥⌘S
Knit Document ⇧⌘K
Compile Report...
Print...
Close ⌘W
Close All ⇧⌘W
Close All Except Current ⌥⇧⌘W
From Text (base)...
From Text (readr)...
From Excel...
From SPSS...
From SAS...
From Stata...
/function
Addins
Run
Source
R Script
R 4.0.3 · /cloud/project/

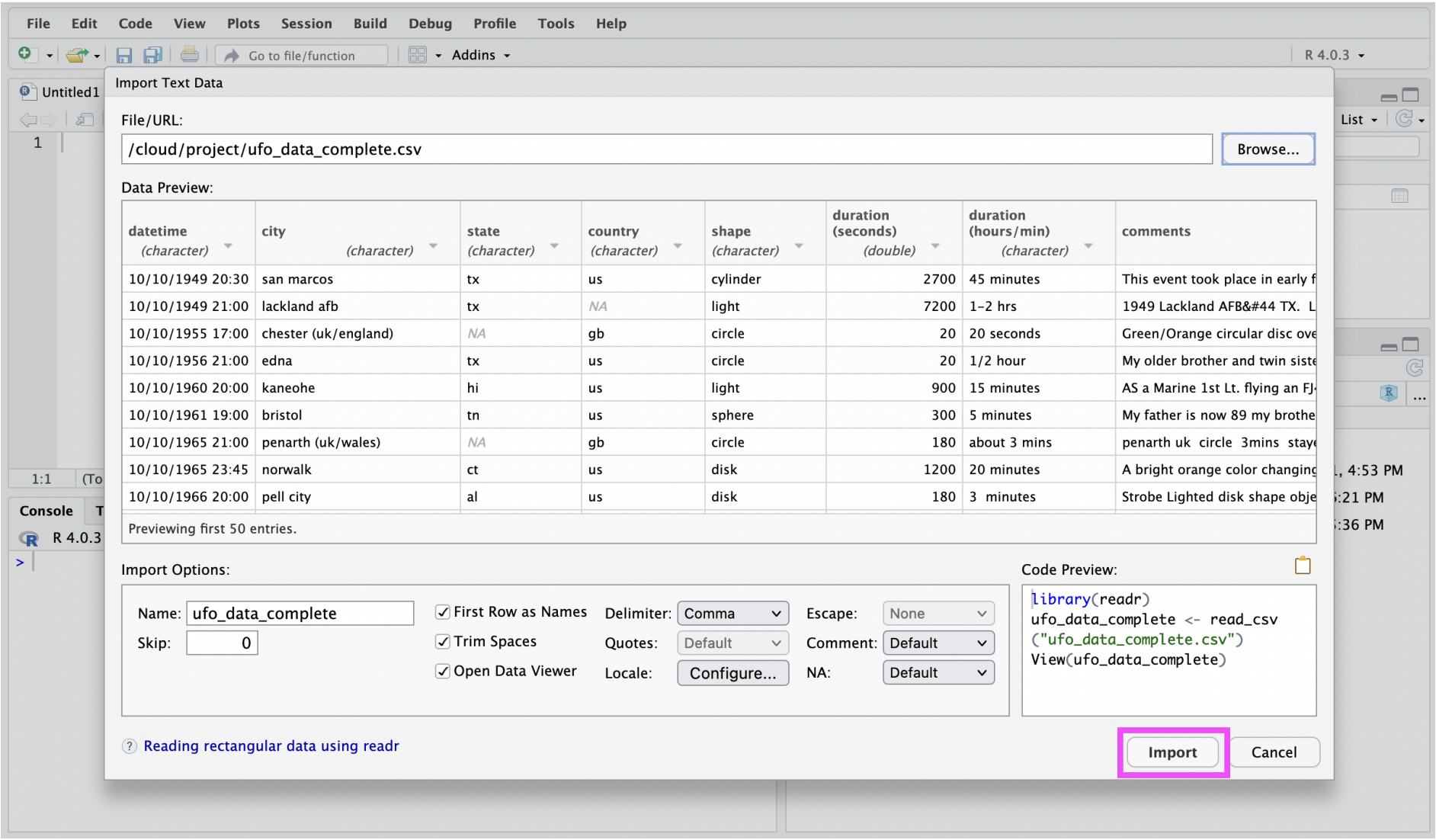
Data Input


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 4.0.3
Untitled1
Import Text Data
File/URL:
Browse...
Data Preview:
Import Options:
Name: dataset
Skip: 0
First Row as Names
Trim Spaces
Open Data Viewer
Delimiter: Comma
Quotes: Default
Locale: Configure...
Escape: None
Comment: Default
NA: Default
Code Preview:
library(readr)
dataset <- read_csv(NULL)
View(dataset)
Reading rectangular data using readr
Import
Cancel
Console
R 4.0.3

Data Input


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 4.0.3
Untitled1
Import Text Data
File/URL:
Browse...
Data Preview:
Choose File
File name: ufo_data_complete.csv
/ cloud project
..
.Rhistory 0 B May 20, 2021, 4:53 PM
project.Rproj 205 B Jul 1, 2021, 6:21 PM
ufo_data_complete.csv 14.6 MB Jul 1, 2021, 5:36 PM
Open
Cancel
Import Options:
Name: dataset
Skip: 0
Code Preview:
library(readr)
dataset <- read_csv(NULL)
View(dataset)
Reading rectangular data using readr
Import
Cancel
Console
R 4.0.3

Data Input


File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 4.0.3
Untitled1
Import Text Data
File/URL:
/cloud/project/ufo_data_complete.csv
Browse...
Data Preview:
datetime (character) | city (character) | state (character) | country (character) | shape (character) | duration (seconds) (double) | duration (hours/min) (character) | comments
10/10/1949 20:30 | san marcos | tx | us | cylinder | 2700 | 45 minutes | This event took place in early f
10/10/1949 21:00 | lackland afb | tx | NA | light | 7200 | 1-2 hrs | 1949 Lackland AFB&#44 TX. L
10/10/1955 17:00 | chester (uk/england) | NA | gb | circle | 20 | 20 seconds | Green/Orange circular disc ove
10/10/1956 21:00 | edna | tx | us | circle | 20 | 1/2 hour | My older brother and twin siste
10/10/1960 20:00 | kaneohe | hi | us | light | 900 | 15 minutes | AS a Marine 1st Lt. flying an FJ
10/10/1961 19:00 | bristol | tn | us | sphere | 300 | 5 minutes | My father is now 89 my brothe
10/10/1965 21:00 | penarth (uk/wales) | NA | gb | circle | 180 | about 3 mins | penarth uk circle 3mins staye
10/10/1965 23:45 | norwalk | ct | us | disk | 1200 | 20 minutes | A bright orange color changing
10/10/1966 20:00 | pell city | al | us | disk | 180 | 3 minutes | Strobe Lighted disk shape obje
Previewing first 50 entries.
Import Options:
Name: ufo_data_complete
Skip: 0
First Row as Names
Trim Spaces
Open Data Viewer
Delimiter: Comma
Quotes: Default
Locale: Configure...
Escape: None
Comment: Default
NA: Default
Code Preview:
library(readr)
ufo_data_complete <- read_csv
("ufo_data_complete.csv")
View(ufo_data_complete)
Reading rectangular data using readr
Import
Cancel

Data Input

Console Terminal Jobs

R 4.0.3 · /cloud/project/

```
> library(readr)
> ufo_data_complete <- read_csv("ufo_data_complete.csv")

── Column specification ────────────────────────────────────────────────────────
cols(
  datetime = col_character(),
  city = col_character(),
  state = col_character(),
  country = col_character(),
  shape = col_character(),
  `duration (seconds)` = col_double(),
  `duration (hours/min)` = col_character(),
  comments = col_character(),
  `date posted` = col_character()
```

Commenting in Scripts

Commenting in code is super important. You should be able to go back to your code years after writing it and figure out exactly what the script is doing. Commenting helps you do this.

avahoffman Add code to save discarded outliers in a csv

1 contributor

127 lines (108 sloc) | 4.16 KB

```r
# Search for outliers among biomass subplots in preparation for the rest of the analysis
##########################################################################################
library(dplyr)
library(ggplot2)
library(cowplot)

# Useful information here: http://r-statistics.co/Outlier-Treatment-With-R.html
##########################################################################################

make_outlier_plot <-
  function(d) {
    # This function will test for chi-square scores that are outside the
    # percentile cutoff, and color them blue.
    # For best results, use only on a specific site-category-treatment subset
    # Probably best for viz only!!
    ggplot() +
      geom_point(aes(
        x = as.numeric(rownames(d)),
```

Commenting in Scripts

Add a comment header to your script from today: `#` is the comment symbol

```
#################
# Title: Demo R Script
# Date: 7/13/2020
# Purpose: Demonstrate comments in R
##################

# nothing to its right is evaluated
x = 2 # but the left will be

# this # is still a comment
### you can use many #s as you want
##### 5 #s or more make a collapsible section

# sometimes if you have a really long comment,
# you can take it to another line
```

R variables

- You can create variables from within the R environment and from files on your computer
- R uses “=” or “<-” to assign values to a variable name
- Variable names are case-sensitive, i.e. X and x are different

```
x = 2 # Same as: x <- 2
x
```

```
[1] 2
```

```
x * 4
```

```
[1] 8
```

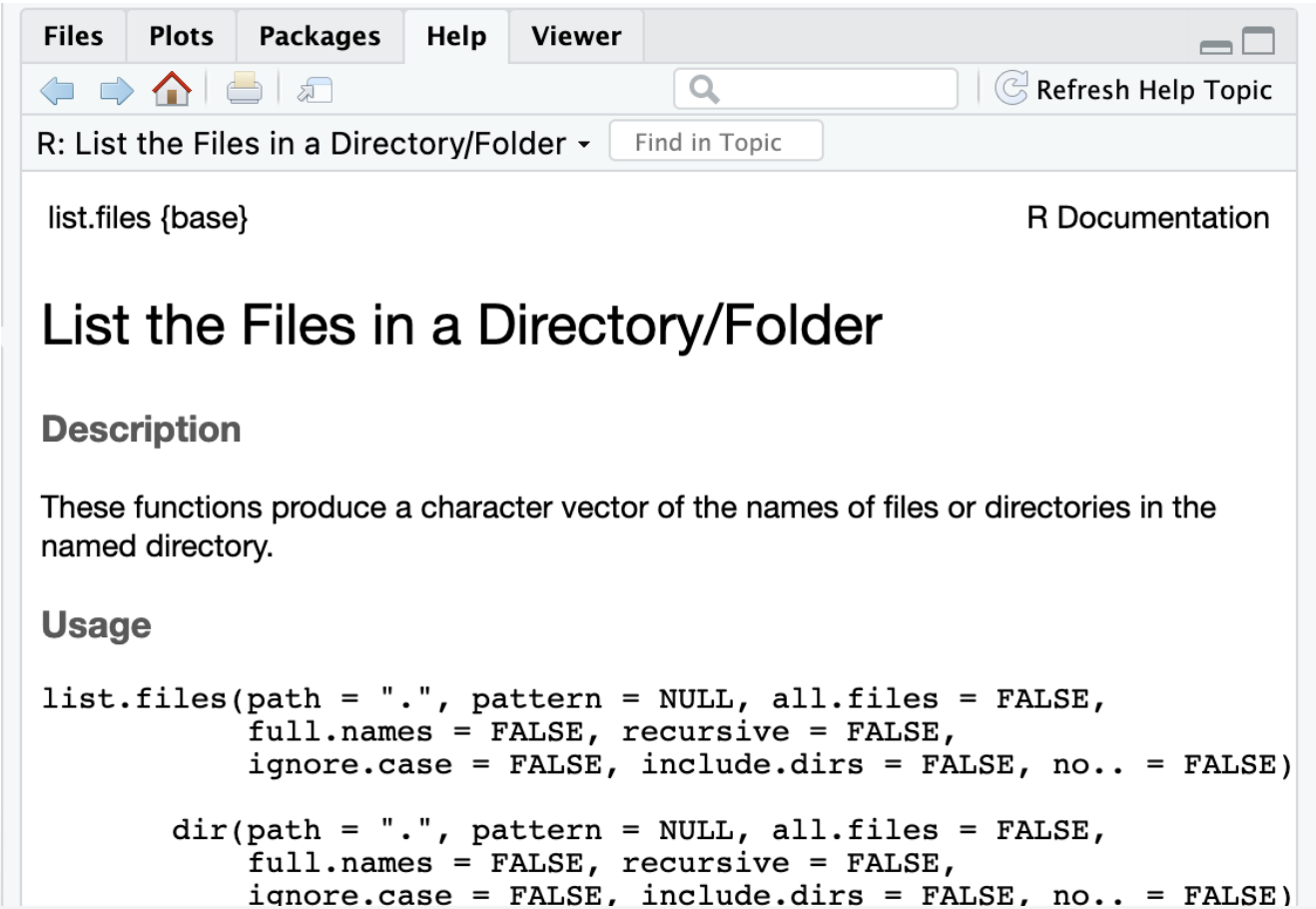
```
x + 2
```

```
[1] 4
```

Help

For any function, you can write `?FUNCTION_NAME`, or `help("FUNCTION_NAME")` to look at the help file:

```
?dir
help("dir")
```



Data Input

Initially-harder-but-gets-way-easier method: Utilizing functions in the `readr` package called `read_delim()` and `read_csv()` with code.

Data Input

So what is going on “behind the scenes”?

`read_delim()`: Read a delimited file into a data frame.

```
function (file, delim, quote = "\"", escape_backslash = FALSE,
    escape_double = TRUE, col_names = TRUE, col_types = NULL,
    locale = default_locale(), na = c("", "NA"), quoted_na = TRUE,
    comment = "", trim_ws = FALSE, skip = 0, n_max = Inf, guess_max = min(1000
        n_max), progress = show_progress(), skip_empty_rows = TRUE)
NULL
```

```r
# example:
read_delim(file = "file.txt", delim = "\t")
read_delim("file.txt", "\t")
```

Data Input

- The filename is the path to your file, in quotes
- The function will look in your “working directory” if no absolute file path is given
- Note that the filename can also be a path to a file on a website (e.g. ‘www.someurl.com/table1.txt’)

Data Input

There is another convenient function for reading in CSV files, where the delimiter is assumed to be a comma:

```
ufo = read_csv("../data/ufo/ufo_data_complete.csv")
```

```
── Column specification ────────────────────────────────────────────────────────
cols(
  datetime = col_character(),
  city = col_character(),
  state = col_character(),
  country = col_character(),
  shape = col_character(),
  `duration (seconds)` = col_double(),
  `duration (hours/min)` = col_character(),
  comments = col_character(),
  `date posted` = col_character(),
  latitude = col_character(),
  longitude = col_double()
)

Warning: 199 parsing failures.
 row col   expected     actual                                   file
 877  -- 11 columns 12 columns '../data/ufo/ufo_data_complete.csv'
1712  -- 11 columns 12 columns '../data/ufo/ufo_data_complete.csv'
1814  -- 11 columns 12 columns '../data/ufo/ufo_data_complete.csv'
2857  -- 11 columns 12 columns '../data/ufo/ufo_data_complete.csv'
3733  -- 11 columns 12 columns '../data/ufo/ufo_data_complete.csv'
```

Data Input

The `read_delim()` and related functions return a “tibble” is a `data.frame` with special printing, which is the primary data format for most data cleaning and analyses.

```
class(ufo)
```

```
[1] "spec_tbl_df" "tbl_df"      "tbl"         "data.frame"
```

Data Input

```
ufo
```

```
# A tibble: 88,875 x 11
   datetime city  state country shape `duration (seco… `duration (hour… commen
   <chr>    <chr> <chr> <chr>   <chr>             <dbl> <chr>            <chr>
 1 10/10/1… san … tx    us      cyli…              2700 45 minutes       This e
 2 10/10/1… lack… tx    <NA>    light              7200 1-2 hrs          1949 I
 3 10/10/1… ches… <NA>  gb      circ…                20 20 seconds       Green/
 4 10/10/1… edna  tx    us      circ…                20 1/2 hour         My olc
 5 10/10/1… kane… hi    us      light               900 15 minutes       AS a M
 6 10/10/1… bris… tn    us      sphe…               300 5 minutes        My fat
 7 10/10/1… pena… <NA>  gb      circ…               180 about 3 mins     penart
 8 10/10/1… norw… ct    us      disk               1200 20 minutes       A brig
 9 10/10/1… pell… al    us      disk               180 3  minutes        Strobe
10 10/10/1… live… fl    us      disk               120 several minutes   Saucer
# … with 88,865 more rows, and 3 more variables: date posted <chr>,
#   latitude <chr>, longitude <dbl>
```

Data Input

There are also data importing functions provided in base R (rather than the `readr` package), like `read.delim` and `read.csv`.

These functions have slightly different syntax for reading in data, like `header` and `as.is`.

However, while many online resources use the base R tools, recent versions of RStudio switched to use these new `readr` data import tools, so we will use them in the class for slides. They are also up to two times faster for reading in large datasets, and have a progress bar which is nice.

Data Input - Excel

Many data analysts collaborate with researchers who use Excel to enter and curate their data. Often times, this is the input data for an analysis. You therefore have two options for getting this data into R:

- Saving the Excel sheet as a .csv file, and using `read_csv()`
- Using an add-on package, like `readxl`, the `read_excel` function

For single worksheet .xlsx files, better to keep the XLSX file as the raw data as Excel exporting CSV can make slight changes (but I often have to strip off additional summary data from the columns).

Data Input - Other Software

- `haven` package (https://cran.r-project.org/web/packages/haven/index.html) reads in SAS, SPSS, Stata formats
- `sas7bdat` reads .sas7bdat files
- `sf` & `rgdal` read in spatial data
- `pdftools` reads .pdf, but things can get tricky quickly

Common new user mistakes we have seen

1. **Working directory problems: trying to read files that R "can't find"**
   - RStudio can help, and so do RStudio Projects
2. Lack of comments in code
3. Typos (R is **case sensitive**, `x` and `X` are different)
   - RStudio helps with "tab completion"
4. Data type problems (is that a string or a number?)
5. Open ended quotes, parentheses, and brackets

Working Directories

- R “looks” for files on your computer (or cloud) relative to the “working” directory
- Best practice is to double-click an R file to start a new RStudio session, instead of launching RStudio from Desktop or somewhere else.
  - it sets the working directory to match that file
  - RStudio Cloud can simplify things
- If you do set a working directory, do it at the beginning of your script.
- Example of getting and setting the working directory:

```
## get the working directory
getwd()
setwd("~/Lectures")
```