Data I/O + Structure

Data Wrangling in R

Data Input

Outline

- Part 0: A little bit of set up!
- Part 1: reading in manually (point and click)
- Part 2: reading in directly & working directories
- Part 3: checking data & multiple file formats

Data Input: `readr`

`read_delim()` and `read_csv()` from the `readr` package

```
# example for character delimited:
read_delim(file = "file.txt", delim = "\t")
# comma delimited:
read_csv("file.csv")
```

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’)

Example

https://sisbid.github.io/Data-Wrangling/data/ufo/ufo_data_complete.csv

```
# From URL
ufo <- read_csv(
  "https://sisbid.github.io/Data-Wrangling/data/ufo/ufo_data_complete.csv"
)

# From your 'data-wrangling' directory
ufo <- read_csv("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"
```

Check to make sure you see the new object in the Environment pane.

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 here. They are also up to two times faster for reading in large datasets, and have a progress bar which is nice.

Data Input: `readr`

`read_table()` from the `readr` package, allows any number of whitespace characters between columns, and the lines can be of different lengths.

```
# example for whitespace delimited :
read_table(file = "file.txt")
```

Clean the data while you read it in!

Some data have different values for `NA`. We can account for that from the start!

```
vacc <- read_csv(
  "https://sisbid.github.io/Data-Wrangling/data/vaccinations_1.csv"
)
vacc_na <- read_csv(
  "https://sisbid.github.io/Data-Wrangling/data/vaccinations_1.csv",
  na = '"NaN"'
)
```

Check out the difference

```
vacc[1:3,1:4]
```

```
# A tibble: 3 × 4
  `State/Territory/Federal Entity` `Total Doses Delivered` `People with at least One Dose by State of Residence` `Percent
  <chr>                            <chr>                   <chr>                                                   <chr>
1 United States                    "644652095"             "247695845"                                             "\"NaN\"
2 Alaska                           "\"NaN\""               "480353"                                                "65.7"
3 Alabama                          "8622020"               "\"NaN\""                                               "59.3"
```

```
vacc_na[1:3,1:4]
```

```
# A tibble: 3 × 4
  `State/Territory/Federal Entity` `Total Doses Delivered` `People with at least One Dose by State of Residence` `Percent
  <chr>                                              <dbl>                                                  <dbl>
1 United States                                  644652095                                              247695845
2 Alaska                                                NA                                                 480353
3 Alabama                                          8622020                                                     NA
```

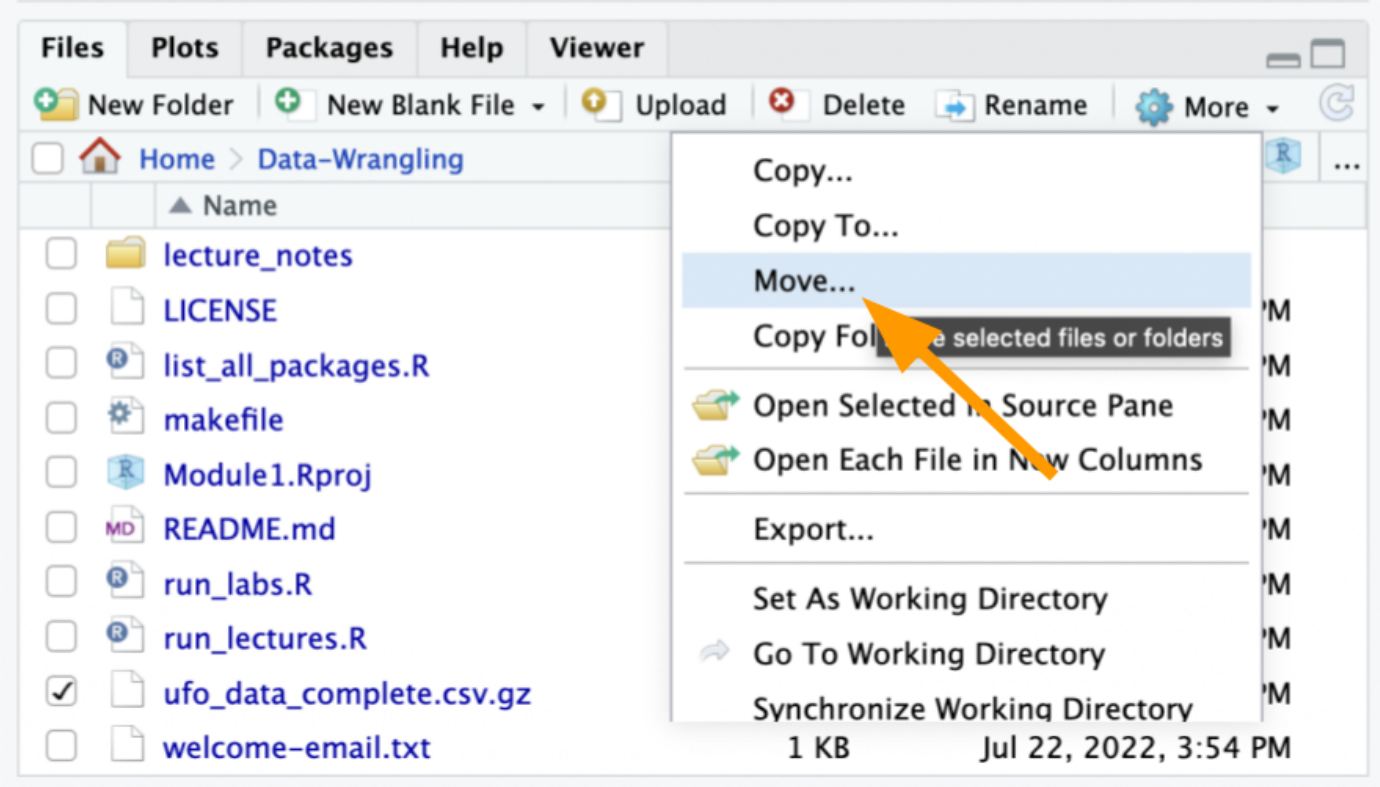
Clean the data while you read it in!

The argument `trim_ws` removes trailing and leading spaces around your data.

```
# example:
read_csv(file = "file.txt", trim_ws = TRUE)
```

Data Input - working directories

What if your file is in the “Home” directory?



Data Input

Backtrack using the relative path with `../` like:

```
ufo <- read_csv("../ufo_data_complete.csv.gz")
```

Data Input

Or, read in from a subfolder:

```
ufo <- read_csv("data/ufo/ufo_data_complete.csv")
```

```
Warning: One or more parsing issues, call `problems()` on your data frame for
  dat <- vroom(...)
  problems(dat)

Rows: 88875 Columns: 11
── Column specification ────────────────────────────────────────────────────────
Delimiter: ","
chr (10): datetime, city, state, country, shape, duration (hours/min), comment
dbl  (1): duration (seconds)

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this messa
```

Check the data + other formats

Check the data out

- Some functions to look at a data frame:
  - `head()` shows first few rows
  - `tail()` shows the last few rows
  - `View()` shows the data as a spreadsheet
  - `spec()` gives specification of column types
  - `str()` gives the column types and specs
  - `glimpse()` similar to `str` (dplyr package)

What did I just read in?

- `nrow()` displays the number of rows of a data frame
- `ncol()` displays the number of columns
- `dim()` displays a vector of length 2: # rows, # columns

```
nrow(ufo)
```

```
[1] 88875
```

```
ncol(ufo)
```

```
[1] 11
```

```
dim(ufo)
```

```
[1] 88875    11
```

All Column Names

- `colnames()` displays the column names

```
colnames(ufo)
```

```
 [1] "datetime"              "city"                  "state"                 "cou
 [8] "comments"              "date posted"           "latitude"              "lon
```

Structure using `str()`

```
str(ufo)
```

```
spc_tbl_ [88,875 × 11] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
 $ datetime            : chr [1:88875] "10/10/1949 20:30" "10/10/1949 21:00" "
 $ city                : chr [1:88875] "san marcos" "lackland afb" "chester (u
 $ state               : chr [1:88875] "tx" "tx" NA "tx" ...
 $ country             : chr [1:88875] "us" NA "gb" "us" ...
 $ shape               : chr [1:88875] "cylinder" "light" "circle" "circle" ..
 $ duration (seconds)  : num [1:88875] 2700 7200 20 20 900 300 180 1200 180 12
 $ duration (hours/min): chr [1:88875] "45 minutes" "1-2 hrs" "20 seconds" "1/
 $ comments            : chr [1:88875] "This event took place in early fall ar
 $ date posted         : chr [1:88875] "4/27/2004" "12/16/2005" "1/21/2008" "1
 $ latitude            : chr [1:88875] "29.8830556" "29.38421" "53.2" "28.9783
 $ longitude           : chr [1:88875] "-97.9411111" "-98.581082" "-2.916667"
 - attr(*, "spec")=
  .. 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_character()
  .. )
```

Data Input

- Sometimes you get weird messages when reading in data.
- The problems()` function shows you any issues with the data read-in.

```
head(problems(ufo))
```

```
# A tibble: 6 × 5
    row   col expected   actual     file
  <int> <int> <chr>      <chr>      <chr>
1   878    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
2  1713    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
3  1815    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
4  2858    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
5  3734    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
6  4756    12 11 columns 12 columns /Users/avahoffman/Dropbox/JHSPH/Data-Wrang
```

```
dim(problems(ufo))
```

```
[1] 199   5
```

Data input: other file types

- For reading Excel files, you can do one of:
  - use `read_excel()` function from `readxl` package
  - use other packages: `xlsx`, `openxlsx`
- `haven` package has functions to read SAS, SPSS, Stata formats

Selecting Excel sheets

Use the `sheet` argument to indicate which sheet to pull from. It can refer to the sheet's index or name.

```
# example:
read_excel(file = "file.xlsx", sheet = 2)
read_excel(file = "file.xlsx", sheet = "data")
```

After hours of cleaning… output!

Data Output

While its nice to be able to read in a variety of data formats, it's equally important to be able to output data somewhere.

`write_delim()`: Write a data frame to a delimited file `write_csv()`: Write a data frame to a comma-delimited file

This is about twice as fast as `write.csv()`, and never writes row names.

Data Output

For example, we can write back out just the first 100 lines of the `ufo` dataset:

```
first_100 <- ufo[1:100,]
write_delim(first_100, file = "ufo_first100.csv", delim = ",")
write_csv(first_100, file = "ufo_first100.csv")
```

More ways to save: `write_rds`

If you want to save **one** object, you can use `readr::write_rds` to save to a compressed `rds` file:

```
write_rds(ufo, file = "ufo_dataset.rds", compress = "xz")
```

Read it back in:

```
ufo_new <- read_rds(file = "ufo_dataset.rds")
```

More ways to save: `save`

The `save` command can save a set of `R` objects into an "R data file", with the extension `.rda` or `.RData`.

```
x = 5
save(ufo, x, file = "ufo_data.rda")
```

The opposite of `save` is `load`.

```
load(file = "ufo_data.rda")
```

Summary & Lab

- Use `read_delim()`, `read_csv()`, `read_table()` for common data types
- These have helpful `trim_ws` and `na` arguments!
- `read_excel()` has the `sheet` argument for reading from different sheets of the Excel file
- Many functions like `str()`, `View()`, and `glimpse()` can help you understand your data better
- Save your data with `write_delim()` and `write_csv()`

https://sisbid.github.io/Data-Wrangling/labs/data-io-lab-part2.Rmd