Week 2: Tabular Data

LSE MY472: Data for Data Scientists
https://lse-my472.github.io/

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Plan for today

- “Tidy data” and reshaping data in R
- Some good practises for code in (research) projects
- Coding

“Tidy data” and reshaping data in R

What is data?

- We can distinguish **data** . . .
  - Representations, symbols, variables
  - E.g. “All”, “the”, “world’s”, “a”, “stage”
- . . . from **information**
  - The meaning and context we gain from organizing and assembling data
  - E.g. “All the world’s a stage”
- Data are a convenient way of *storing* and *transmitting* information
  - See Caleb Sharf’s “The Ascent of Information” (2021)

Shapes of data

- One very common form of data is tabular
- Examples of other forms: Raw texts, key-value and array structures such as JSON files
- This week: How to organise and process tabular data (in R)
- Helpful to think about an ideal format of tabular data first

Comparing data structures

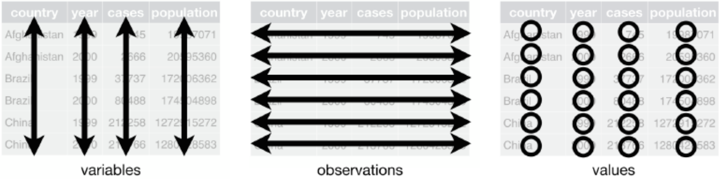
	tweet	tags	lists	list_descriptions
1	I think MY472 is the best course ever	LSE, MY472	asds_tweets, publicity	my thoughts, to share

```
{
    "tweet" : {
        "message" : "I think MY472 is the best course ever",
        "tags" : ["LSE", "MY472"],
        "lists" : [
            {
                "name" : "asds_tweets",
                "description" : "my thoughts"
            },
            {
                "name" : "publicity",
                "description" : "to share"
            }
        ]
    }
}
```

“Tidy” data (Hadley Wickham)

Three rules:

1. Each variable must have its own column
2. Each observation must have its own row
3. Each value must have its own cell



Section based on https://r4ds.had.co.nz/tidy-data.html

What can go wrong?

Datasets where columns represent values of a variable:

```
table4a
#> # A tibble: 3 x 3
#>   country      `1999` `2000`
#> * <chr>         <int>  <int>
#> 1 Afghanistan     745   2666
#> 2 Brazil        37737  80488
#> 3 China        212258 213766
```

How to fix it?

We need to **pivot** those columns into a new pair of variables:

```
table4a %>%
  pivot_longer(c(`1999`, `2000`), names_to = "year",
  values_to = "cases")
#> # A tibble: 6 x 3
#>   country     year   cases
#>   <chr>       <chr>  <int>
#> 1 Afghanistan 1999     745
#> 2 Afghanistan 2000    2666
#> 3 Brazil      1999   37737
#> 4 Brazil      2000   80488
#> 5 China       1999  212258
#> 6 China       2000  213766
```

What is happening here?

We switched from **wide** to **long** format:

What **else can go wrong?**

Datasets where observations are scattered across multiple rows:

```
table2
#> # A tibble: 12 x 4
#>   country      year type            count
#>   <chr>       <int> <chr>           <int>
#> 1 Afghanistan  1999 cases             745
#> 2 Afghanistan  1999 population   19987071
#> 3 Afghanistan  2000 cases            2666
#> 4 Afghanistan  2000 population   20595360
#> 5 Brazil       1999 cases           37737
#> 6 Brazil       1999 population  172006362
#> # ... with 6 more rows
```

How to fix it?

We need to **pivot** those rows into a new pair of columns:

```
table2 %>%
    pivot_wider(names_from = type, values_from = count)
#> # A tibble: 6 x 4
#>   country      year  cases population
#>   <chr>       <int>  <int>      <int>
#> 1 Afghanistan  1999    745   19987071
#> 2 Afghanistan  2000   2666   20595360
#> 3 Brazil       1999  37737  172006362
#> 4 Brazil       2000  80488  174504898
#> 5 China        1999 212258 1272915272
#> 6 China        2000 213766 1280428583
```

What is happening here?

We switched from **long** to **wide** format:

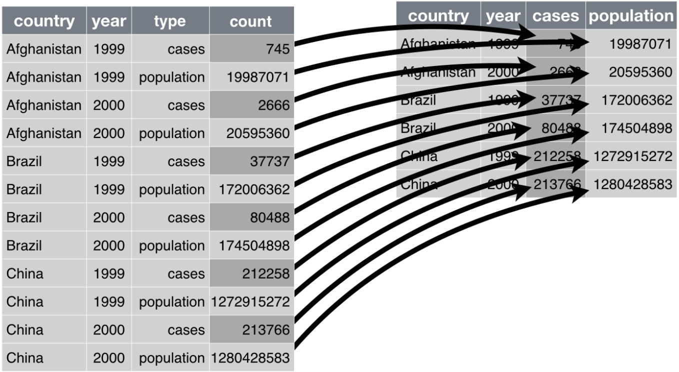


table2

Storing tabular data

Common file formats for storing tabular data:

- Comma-separated values (.csv) – ubiquitous and simple
  - Each *line* is an observation
  - Each variable value is separated by a comma
- Application specific (proprietary) formats (.dta, .sav, .xls etc.)
  - Can allow for richer representations including meta-data
  - More complex, and not necessarily human-readable
  - Can have explicit data limits (e.g. see Public Health England's use of .xls spreadsheets)

Often choice is dictated by the source (and size) of the data

- Packages like `haven` allow for reading in non-csv formats in R

Be very careful when storing data!

Some good practises for code in (research) projects

Good practices in scientific computing

- Before we continue with examples of processing tabular data in R, it is helpful to spend some time early in this course with a brief discussion of good coding practises
- Based on Nagler (1995) "Coding Style and Good Computing Practices" (PS) and Wilson *et al* (2017) "Good Enough Practices in Scientific Computing" (PLOS Comput Biol)

Good practices in scientific computing

Why care?

- Yourself
  - Much lower chance of unnoticed bugs
  - Future self will be grateful: "Yourself from 3 months ago doesn't answer emails"
  - More efficient research, avoid retracing own steps
- Others
  - Keep good records of what you did so that others can understand it
  - **Replication** is a key part of science

Summary of some good practices

1. Safe and efficient data management
2. Well organised and documented code
3. Organised collaboration
4. One project = one repository
5. Track changes
6. Manuscripts as part of the analysis

1. Data management

- Save raw data as originally generated
- Create the data you would like to see, e.g.
  - If possible, open and non-proprietary formats such as `.csv`
  - Informative variable names instead of `V322`
  - Informative file names that contain metadata:
    e.g. `05-alaska.csv` instead of `state5.csv`
- Record all steps used to process data and store intermediate data files if computationally intensive (easier to rerun parts of a data analysis pipeline)
- Separate data manipulation from data analysis
- Prepare README with codebook of all variables
- Periodic backups (or Dropbox, Google Drive, etc.)
- Sanity checks: Summary statistics after data manipulation

2.Well organised and documented code

- Number scripts based on execution order
  - e.g. `01-clean-data.R`, `02-recode-variables.R`, `03-run-regression.R`, `04-produce-figures.R`...
- Write an explanatory note at the start of each script
  - Author, date of last update, purpose, inputs and outputs, other relevant notes
- Rules of thumb for modular code
  1. Any task you run more than once should be a function (with a meaningful name!)
  2. Many functions can be relatively short
  3. Can separate functions from execution (e.g. in `functions.R` file and then use `source(functions.R)` to load functions into current environment
- Try to keep it simple rather than too clever
- Add informative comments before blocks of code

3. Organised collaboration

- ➜ Create a `README` file with an overview of the project: Title, brief description, contact information, structure of folder
- ➜ Shared to-do list with tasks and deadlines
- ➜ Choose one person as corresponding author / point of contact / note taker
- ➜ Split code into multiple scripts to avoid simultaneous edits
- ➜ GitHub, ShareLatex, Overleaf, Google Docs, etc. to collaborate in writing of manuscript

4. One project = one repository

Logical and consistent folder structure:

- `code` or `src` for all scripts
- `data` for raw data
- `temp` for temporary data files
- `output` or `results` for final data files and tables
- `figures` or `plots` for figures produced by scripts
- `manuscript` for text of paper
- `docs` for any additional documentation

5 & 6. Track changes; producing manuscript

- Ideally: Use version control (e.g. Git/GitHub)
- Manual approach: Keep dates versions of code & manuscript, and a `changelog` file with list of changes
- Dropbox also has some basic version control built-in
- Avoid typos and copy&paste errors: Tables and figures can be produced in scripts and compiled directly into manuscript with LaTeX

Examples

Replication materials for Pablo Barberá's 2014 *Political Analysis* paper:

- ➜ Code on GitHub
- ➜ Code and Data

John Myles White's ProjectTemplate R package.

Another example of replication materials, Thomas Leeper (2017):

- ➜ Code and data

Coding

Coding

- `01-conditionals-loops-functions.Rmd`
- `02-processing-data.Rmd`