Tidy Data and Tidying Data

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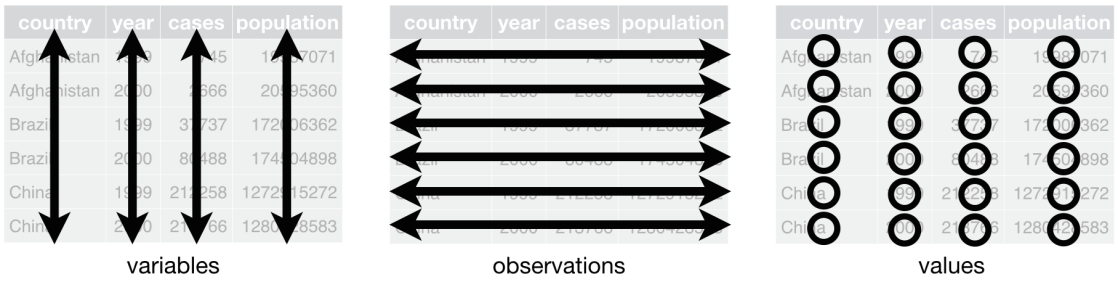
Learning Objectives

- What is tidy data?
- Learn to make your data tidy with `gather()`, `spread()`, `separate()`, and `unite()`.
- Chapter 12 of RDS
- Data Import Cheat Sheet
- Tidyr Overview.

Tidy Data

- Recall:
  - Observations/units/subjects/individuals/cases: objects described by a set of data (e.g. cars, people, countries).
  - Variable: describes some characteristic of the units (e.g. mpg, age, GDP).
  - Each unit has a single value of each variable (e.g. 20 mpg, 31 years old, $20,513,000 US$million).
- Tidy Data:
  - One unit per row.
  - One variable per column.
  - One value per cell.
- Hadley's visualization:



- We will use the tidyr package (a member of the tidyverse) to make data tidy.

```
library(tidyverse)
```

- Example of tidy data:

```
tidyr::table1
```

```
## # 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
```

  - Variables: Country, Year, Cases, Population
  - Units: location×time

- Untidy data: Each unit is spread across multiple rows

```
print(tidyr::table2, n = 12)
```

```
## # 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
##  7 Brazil       2000 cases           80488
##  8 Brazil       2000 population  174504898
##  9 China        1999 cases          212258
## 10 China        1999 population 1272915272
## 11 China        2000 cases          213766
## 12 China        2000 population 1280428583
```

- Untidy data: Two variables are in one column

```
tidyr::table3
```

```
## # A tibble: 6 x 3
##   country      year rate
## * <chr>       <int> <chr>
## 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
```

- Untidy data: Data are spread across two data frames. Within each data frame, multiple units are in one row.

```
tidyr::table4a
```

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

```
tidyr::table4b
```

```
## # A tibble: 3 x 3
##   country         `1999`     `2000`
## * <chr>            <int>      <int>
## 1 Afghanistan   19987071   20595360
## 2 Brazil       172006362  174504898
## 3 China       1272915272 1280428583
```

- Sometimes it is easy to determine the units and the variables.
- Sometimes it is very hard and you need to talk to the data collectors to find out.
- We want tidy data because R easily manipulates vectors. So in the long run it will make your life easier to first make data tidy.

Gather

- Problem: One variable spread across multiple columns.
- Column names are actually *values* of a variable
- `table4a` and `table4b`
- Solution: `gather()`
- Hadley's visualization:

- Specify

  i. The columns that are values, not variables,
  ii. The name of the variable that will take the values of the column names (`key`), and
  iii. The name of the variable that will take the values spread in the cells (`value`).

```
tidyr::table4a %>%
  gather(`1999`, `2000`, key = "Year", value = "cases") ->
  tidy4a
tidy4a
```

```
## # A tibble: 6 x 3
##   country     Year   cases
##   <chr>       <chr>  <int>
## 1 Afghanistan 1999     745
## 2 Brazil      1999   37737
## 3 China       1999  212258
## 4 Afghanistan 2000    2666
## 5 Brazil      2000   80488
## 6 China       2000  213766
```

```
tidyr::table4b %>%
  gather(`1999`, `2000`, key = "Year", value = "population") ->
  tidy4b
tidy4b
```

```
## # A tibble: 6 x 3
##   country     Year  population
##   <chr>       <chr>      <int>
## 1 Afghanistan 1999    19987071
## 2 Brazil      1999   172006362
## 3 China       1999  1272915272
## 4 Afghanistan 2000    20595360
## 5 Brazil      2000   174504898
## 6 China       2000  1280428583
```

- We will learn next class how to join these two data frames next week. But the code is

```
full_join(tidy4a, tidy4b)
```

```
## Joining, by = c("country", "Year")
```

```
## # A tibble: 6 x 4
##   country     Year   cases population
##   <chr>       <chr>  <int>      <int>
## 1 Afghanistan 1999     745   19987071
## 2 Brazil      1999   37737  172006362
## 3 China       1999  212258 1272915272
## 4 Afghanistan 2000    2666   20595360
## 5 Brazil      2000   80488  174504898
## 6 China       2000  213766 1280428583
```

- **Exercise**: gather the `monkeymem` data frame (available at https://dcgerard.github.io/stat_412_612/data/monkeymem.csv). The cell values represent identification accuracy of some objects (in percent of 20 trials).
- **Exercise** (RDS 12.3.3.1): Why does this code fail?

```
table4a %>%
  gather(1999, 2000, key = "year", value = "cases")
```

```
## Error in inds_combine(.vars, ind_list): Position must be between 0 and n
```

Spread

- Problem: One observation is spread across multiple rows.
- One column contains variable names. One column contains values for the different variables.
- `table2`
- Solution: `spread()`
- Hadley's visualization:

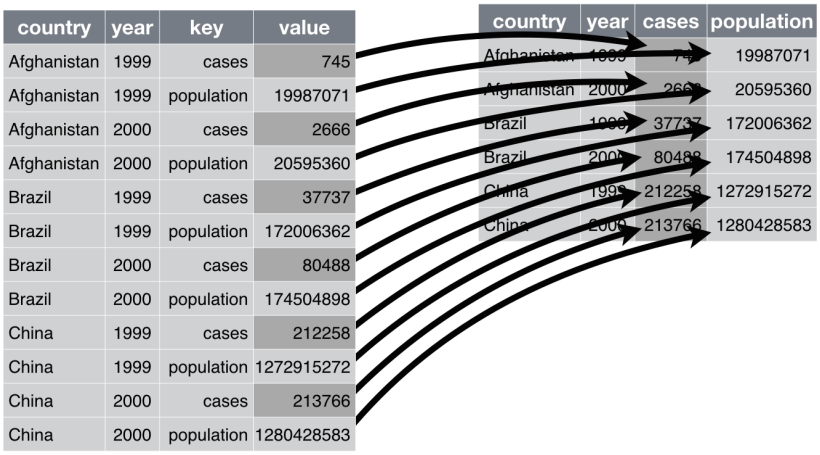


table2

- Specify:

  i. The column that contains the column names (`key`), and
  ii. The column that contains the values (`value`).

```
table2 %>%
  spread(key = type, value = 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
```

- **Exercise**: Spread the `flowers1` data frame (available at https://dcgerard.github.io/stat_412_612/data/flowers1.csv).
- **Exercise** (RDS 13.3.3.3): Why does spreading this data frame fail?

```
people <- tribble(
  ~name,             ~key,    ~value,
  #-----------------/--------/------
  "Phillip Woods",   "age",       45,
  "Phillip Woods",   "height",   186,
  "Phillip Woods",   "age",       50,
  "Jessica Cordero", "age",       37,
  "Jessica Cordero", "height",   156
)
```

Separate

- Problem: One column contains two (or more) variables.
- `table3`
- Solution: `separate()`
- Hadley's visualization:

country	year	rate
Afghanistan	1999	**745** / 19987071
Afghanistan	2000	**2666** / 20595360
Brazil	1999	**37737** / 172006362
Brazil	2000	**80488** / 174504898
China	1999	**212258** / 1272915272
China	2000	**213766** / 1280428583

country	year	cases	population
Afghanistan	1999	**745**	19987071
Afghanistan	2000	**2666**	20595360
Brazil	1999	**37737**	172006362
Brazil	2000	**80488**	174504898
China	1999	**212258**	1272915272
China	2000	**213766**	1280428583

table3

- Specify:

  i. The column that contains two (or more) variables,
  ii. A character vector of the new names of the variables, and
  iii. The character that separates variables (or the position that separates variables).

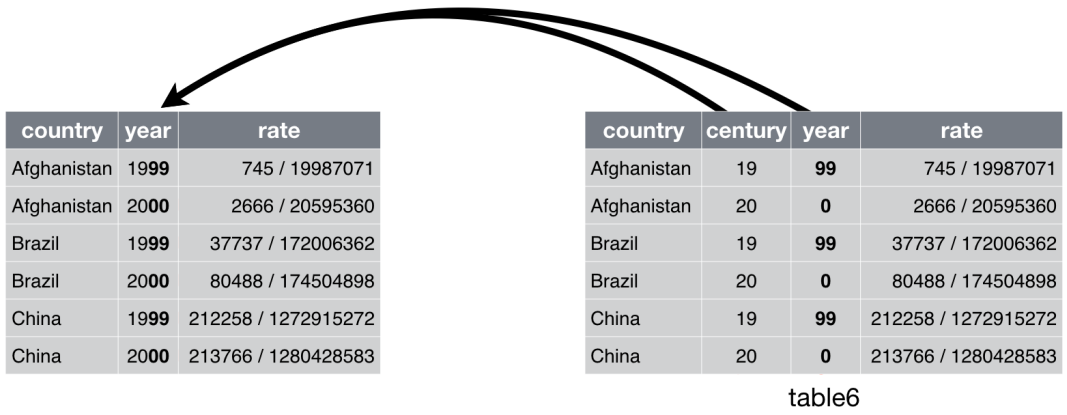
```
table3 %>%
  separate(rate, into = c("cases", "population"), sep = "/")
```

```
## # A tibble: 6 x 4
##   country      year cases  population
##   <chr>       <int> <chr>  <chr>
## 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
```

- **Exercise**: Separate the `flowers2` data frame (available at https://dcgerard.github.io/stat_412_612/data/flowers2.csv).

Unite

- Problem: One variable spread across multiple columns.
- Solution: `unite()`
- Hadley's visualization:



country	year	rate
Afghanistan	1999	745 / 19987071
Afghanistan	2000	2666 / 20595360
Brazil	1999	37737 / 172006362
Brazil	2000	80488 / 174504898
China	1999	212258 / 1272915272
China	2000	213766 / 1280428583

country	century	year	rate
Afghanistan	19	99	745 / 19987071
Afghanistan	20	0	2666 / 20595360
Brazil	19	99	37737 / 172006362
Brazil	20	0	80488 / 174504898
China	19	99	212258 / 1272915272
China	20	0	213766 / 1280428583

table6

- Much less common problem.

```
table5
```

```
## # A tibble: 6 x 4
##   country     century year  rate
## * <chr>       <chr>   <chr> <chr>
## 1 Afghanistan 19      99    745/19987071
## 2 Afghanistan 20      00    2666/20595360
## 3 Brazil      19      99    37737/172006362
## 4 Brazil      20      00    80488/174504898
## 5 China       19      99    212258/1272915272
## 6 China       20      00    213766/1280428583
```

- Specify:

i. The name of the new column (`col`),
ii. The columns to unite, and
iii. The separator of the variables in the new column (`sep`).

```
table5 %>%
  unite(century, year, col = "Year", sep = "")
```

```
## # A tibble: 6 x 3
##   country     Year  rate
##   <chr>       <chr> <chr>
## 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
```

- **Exercise**: Re-unite the data frame you separated from the `flowers2` exercise. Use a comma for the separator.