

Tidying Data

tidyr

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tidyr

Functions for tidying data.

What is tidy data?

“Tidy datasets are all alike, but every messy dataset is messy in its own way.” — Hadley Wickham



Tidy Data

country	year	cases	population
Afghanistan	1999	745	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174604898
China	1999	212258	1272915272
China	2000	216766	1280425583

variables

country	year	cases	population
Afghanistan	1999	745	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174604898
China	1999	212258	1272915272
China	2000	216766	1280425583

observations

country	year	cases	population
Afghanistan	99	745	19987071
Afghanistan	00	2666	20595360
Brazil	99	37737	172006362
Brazil	00	80488	174604898
China	99	212258	1272915272
China	00	216766	1280425583

values

Tidy Data

country	year	cases	population
Afghanistan	1999	745	19987071
Afghanistan	2000	2666	20095360
Brazil	1999	30737	172006362
Brazil	2000	80488	174604898
China	1999	212258	1272915272
China	2000	216766	1280420583

variables

country	year	cases	population
Afghanistan	1999	745	19987071
Afghanistan	2000	2666	20095360
Brazil	1999	30737	172006362
Brazil	2000	80488	174604898
China	1999	212258	1272915272
China	2000	216766	1280420583

observations

country	year	cases	population
Afghanistan	99	745	19987071
Afghanistan	00	2666	20095360
Brazil	99	30737	172006362
Brazil	00	80488	174604898
China	99	212258	1272915272
China	00	216766	1280420583

values

Each **column** is a single **variable**

Tidy Data

country	year	cases	population
Afghanistan	1999	37745	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174604898
China	1999	214258	1272915272
China	2000	216766	1280425583

variables

country	year	cases	population
Afghanistan	1999	37745	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174604898
China	1999	214258	1272915272
China	2000	216766	1280425583

observations

country	year	cases	population
Afghanistan	99	745	987071
Afghanistan	00	666	595360
Brazil	99	737	006362
Brazil	00	0488	604898
China	99	14258	272915272
China	00	16766	425583

values

Each column is a single variable

Each **row** is a single **observation**

Tidy Data

country	year	cases	population
Afghanistan	1999	18145	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174603898
China	1999	212258	1272915272
China	2000	216766	1280425583

variables

country	year	cases	population
Afghanistan	1999	18145	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174603898
China	1999	212258	1272915272
China	2000	216766	1280425583

observations

country	year	cases	population
Afghanistan	1999	18145	19987071
Afghanistan	2000	2666	20595360
Brazil	1999	37737	172006362
Brazil	2000	80488	174603898
China	1999	212258	1272915272
China	2000	216766	1280425583

values

Each column is a single variable

Each row is a single observation

Each **cell** is a **value**

pivot_longer()

```
pivot_longer(<DATA>, <NAMES TO>, <VALUES TO>, <VARIABLES>)
```

Lord of the Rings

```
lotr <- tribble(  
  ~film, ~race, ~female, ~male,  
  "The Fellowship Of The Ring", "Elf", 1229L, 971L,  
  "The Fellowship Of The Ring", "Hobbit", 14L, 3644L,  
  "The Fellowship Of The Ring", "Man", 0L, 1995L,  
  "The Two Towers", "Elf", 331L, 513L,  
  "The Two Towers", "Hobbit", 0L, 2463L,  
  "The Two Towers", "Man", 401L, 3589L,  
  "The Return Of The King", "Elf", 183L, 510L,  
  "The Return Of The King", "Hobbit", 2L, 2673L,  
  "The Return Of The King", "Man", 268L, 2459L  
)
```


Lord of the Rings

```
lotr
```

```
## # A tibble: 9 x 4
##   film                                race    female    male
##   <chr>                                <chr>    <int> <int>
## 1 The Fellowship Of The Ring Elf      1229    971
## 2 The Fellowship Of The Ring Hobbit     14   3644
## 3 The Fellowship Of The Ring Man         0   1995
## 4 The Two Towers Elf        331    513
## 5 The Two Towers Hobbit        0   2463
## 6 The Two Towers Man         401   3589
## 7 The Return Of The King Elf        183    510
## 8 The Return Of The King Hobbit        2   2673
## 9 The Return Of The King Man         268   2459
```



new data alert!



lotr

	film	race	female	male
1	The Fellowship Of The Ring	Elf	1229	971
2	The Fellowship Of The Ring	Hobbit	14	3644
3	The Fellowship Of The Ring	Man	0	1995
4	The Two Towers	Elf	331	513
5	The Two Towers	Hobbit	0	2463
6	The Two Towers	Man	401	3589
7	The Return Of The King	Elf	183	510
8	The Return Of The King	Hobbit	2	2673
9	The Return Of The King	Man	268	2459

Where does it come from?

`exercises.Rmd`

source:

github.com/jennybc/lotr-tidyr

How can I use it?

Run the code at the top of
`exercises.Rmd`

`View(lotr)`



*this saves it in your
global environment*

pivot_longer()

```
lotr %>%  
  pivot_longer(  
    names_to = "sex",  
    values_to = "words",  
    cols = female:male  
  )
```

```
lotr %>%
  pivot_longer(
    names_to = "sex",
    values_to = "words",
    cols = female:male
  )
```

```
## # A tibble: 18 x 4
```

	film	race	sex	words
	<chr>	<chr>	<chr>	<int>
1	The Fellowship Of The Ring	Elf	female	1229
2	The Fellowship Of The Ring	Elf	male	971
3	The Fellowship Of The Ring	Hobbit	female	14
4	The Fellowship Of The Ring	Hobbit	male	3644
5	The Fellowship Of The Ring	Man	female	0
6	The Fellowship Of The Ring	Man	male	1995
7	The Two Towers	Elf	female	331
8	The Two Towers	Elf	male	513
9	The Two Towers	Hobbit	female	0
10	The Two Towers	Hobbit	male	2463

... with 8 more rows



new data alert!



table2, table4a, who

	country	iso2	iso3	year	new_sp_m014
1	Afghanistan	AF	AFG	1980	NA
2	Afghanistan	AF	AFG	1981	NA
3	Afghanistan	AF	AFG	1982	NA
4	Afghanistan	AF	AFG	1983	NA
5	Afghanistan	AF	AFG	1984	NA
6	Afghanistan	AF	AFG	1985	NA
7	Afghanistan	AF	AFG	1986	NA
8	Afghanistan	AF	AFG	1987	NA

	country	1999	2000
1	Afghanistan	745	2666
2	Brazil	37737	80488
3	China	212258	213766

	country	year	type	count
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

Where does it come from?

The tidyr R package

How can I use it?

```
library(tidyr)
View(table2)
View(table4a)
View(who)
```



*they're
invisible!*

Your Turn 1

Use `pivot_longer()` to reorganize `table4a` into three columns: **country**, **year**, and **cases**.

Your Turn 1

```
table4a %>%  
  pivot_longer(  
    names_to = "year",  
    values_to = "cases",  
    cols = -country  
  )
```

```
## # 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
```

pivot_wider()

```
pivot_wider(<DATA>, <NAMES FROM>, <VALUES FROM>)
```


		wide		
id		x	y	z
1		a	c	e
2		b	d	f

Animation by Mara Averick

pivot_wider()

```
lotr %>%  
  pivot_longer(  
    names_to = "sex",  
    values_to = "words",  
    cols = female:male  
  ) %>%  
  pivot_wider(  
    names_from = race,  
    values_from = words  
  )
```

pivot_wider()

```
lotr %>%  
  pivot_longer(  
    names_to = "sex",  
    values_to = "words",  
    cols = female:male  
  ) %>%  
  pivot_wider(  
    names_from = race,  
    values_from = words  
  )
```

pivot_wider()

```
lotr %>%  
  pivot_longer(  
    names_to = "sex",  
    values_to = "words",  
    cols = female:male  
  ) %>%  
  pivot_wider(  
    names_from = race,  
    values_from = words  
  )
```

```
## # A tibble: 6 x 5
```

	film	sex	Elf	Hobbit	Man
	<chr>	<chr>	<int>	<int>	<int>
## 1	The Fellowship Of The Ring	female	1229	14	0
## 2	The Fellowship Of The Ring	male	971	3644	1995
## 3	The Two Towers	female	331	0	401
## 4	The Two Towers	male	513	2463	3589
## 5	The Return Of The King	female	183	2	268
## 6	The Return Of The King	male	510	2673	2459

Your Turn 2

Use `pivot_wider()` to reorganize `table2` into four columns: **country**, **year**, **cases**, and **population**.

Create a new variable called `prevalence` that divides cases by population multiplied by 100000.

Pass the data frame to a `ggplot`. Make a scatter plot with `year` on the x axis and `prevalence` on the y axis. Set the color aesthetic (`aes()`) to `country`. Use `size = 2` for the points. Add a line geom.

```
table2
```

Your Turn 2

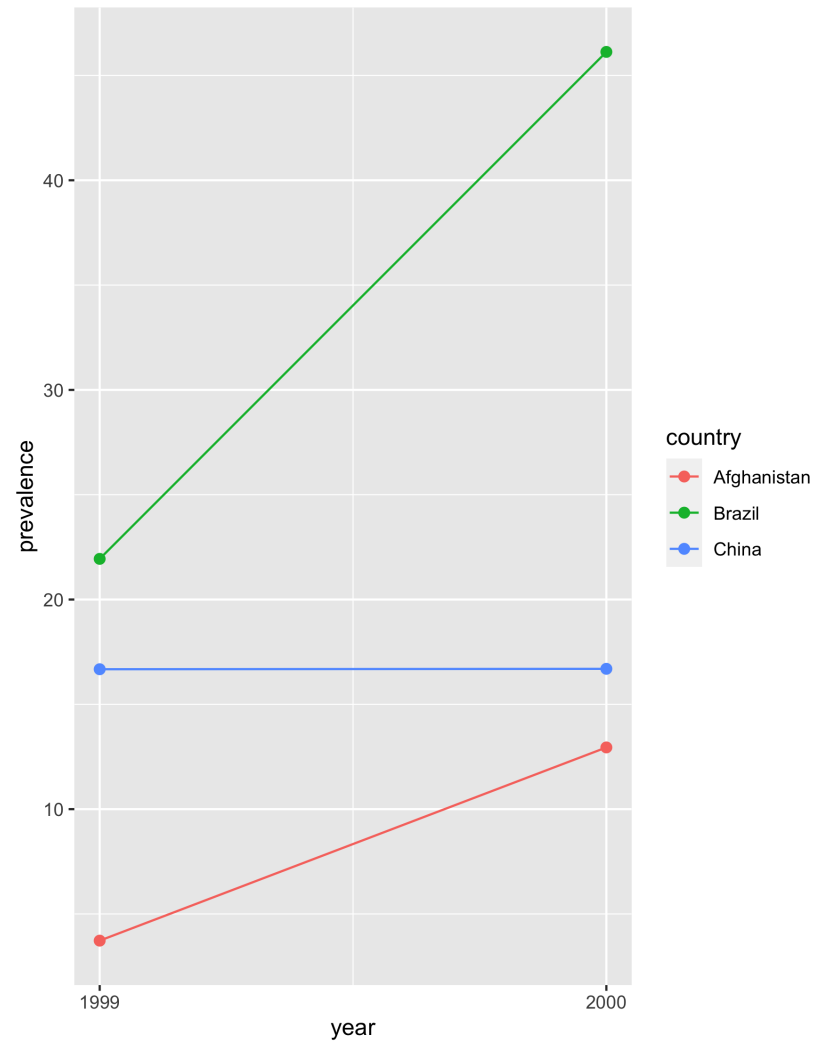
```
table2 %>%  
  pivot_wider(  
    names_from = type,  
    values_from = count  
  ) %>%  
  mutate(prevalence = (cases / population) * 100000)
```

```
## # A tibble: 6 x 5  
##   country      year  cases population prevalence  
##   <chr>      <int> <int>      <int>      <dbl>  
## 1 Afghanistan 1999     745   19987071      3.73  
## 2 Afghanistan 2000    2666   20595360     12.9  
## 3 Brazil      1999   37737   172006362     21.9  
## 4 Brazil      2000   80488   174504898     46.1  
## 5 China       1999  212258  1272915272     16.7  
## 6 China       2000  213766  1280428583     16.7
```

Your Turn 2

```
table2 %>%  
  pivot_wider(  
    names_from = type,  
    values_from = count  
  ) %>%  
  mutate(prevalence = (cases / population) * 100000) %>%  
  ggplot(aes(x = year, y = prevalence, color = country)) +  
  geom_point(size = 2) +  
  geom_line() +  
  scale_x_continuous(breaks = c(1999L, 2000L))
```

Your Turn 2



Your Turn 3

Pivot the 5th through 60th columns of `who` so that the names of the columns go into a new variable called `codes` and the values go into a new variable called `n`. Then select just the `country`, `year`, `codes` and `n` variables.

```
who
```

Your Turn 3

```
who %>%  
  pivot_longer(  
    names_to = "codes",  
    values_to = "n",  
    cols = 5:60  
  ) %>%  
  select(country, year, codes, n)
```

Your Turn 3

```
## # A tibble: 405,440 x 4
##   country      year codes      n
##   <chr>      <int> <chr>    <int>
## 1 Afghanistan  1980 new_sp_m014    NA
## 2 Afghanistan  1980 new_sp_m1524    NA
## 3 Afghanistan  1980 new_sp_m2534    NA
## 4 Afghanistan  1980 new_sp_m3544    NA
## 5 Afghanistan  1980 new_sp_m4554    NA
## 6 Afghanistan  1980 new_sp_m5564    NA
## 7 Afghanistan  1980 new_sp_m65     NA
## 8 Afghanistan  1980 new_sp_f014    NA
## 9 Afghanistan  1980 new_sp_f1524    NA
## 10 Afghanistan 1980 new_sp_f2534    NA
## # ... with 405,430 more rows
```

separate()/unite()

```
separate(<DATA>, <VARIABLE>, into = c("<VARIABLE1>", "<VARIABLE2>"))  
unite(<DATA>, <VARIABLES>)
```

Your Turn 4

Use the cases data below. Separate the sex_age column into **sex** and **age** columns.

```
cases <- tribble(
  ~id,      ~sex_age,
  "1",      "male_56",
  "2",      "female_77",
  "3",      "female_49"
)
separate(_____, _____, into = c("_____", "_____"))
```

Your Turn 4

```
cases <- tribble(  
  ~id,      ~sex_age,  
  "1",      "male_56",  
  "2",      "female_77",  
  "3",      "female_49"  
)  
separate(cases, sex_age, into = c("sex", "age"))
```

Your Turn 4

```
cases <- tribble(  
  ~id,      ~sex_age,  
  "1",      "male_56",  
  "2",      "female_77",  
  "3",      "female_49"  
)  
separate(cases, sex_age, into = c("sex", "age"))
```

```
## # A tibble: 3 x 3  
##   id    sex    age  
##   <chr> <chr>  <chr>  
## 1 1    male   56  
## 2 2    female 77  
## 3 3    female 49
```

Your Turn 4

```
cases <- tribble(
  ~id,      ~sex_age,
  "1",      "male_56",
  "2",      "female_77",
  "3",      "female_49"
)
separate(cases, sex_age, into = c("sex", "age"))
```

```
## # A tibble: 3 x 3
##   id    sex    age
##   <chr> <chr>  <chr>
## 1 1    male   56
## 2 2    female 77
## 3 3    female 49
```


Your Turn 4

```
cases <- tribble(
  ~id,      ~sex_age,
  "1",      "male_56",
  "2",      "female_77",
  "3",      "female_49"
)
separate(cases, sex_age, into = c("sex", "age"), convert = TRUE)
```

```
## # A tibble: 3 x 3
##   id    sex    age
##   <chr> <chr>  <int>
## 1 1    male    56
## 2 2    female  77
## 3 3    female  49
```

Your Turn 5: Challenge!

There are two CSV files in this folder containing SEER data in breast cancer incidence in white and black women. For both sets of data:

Import the data

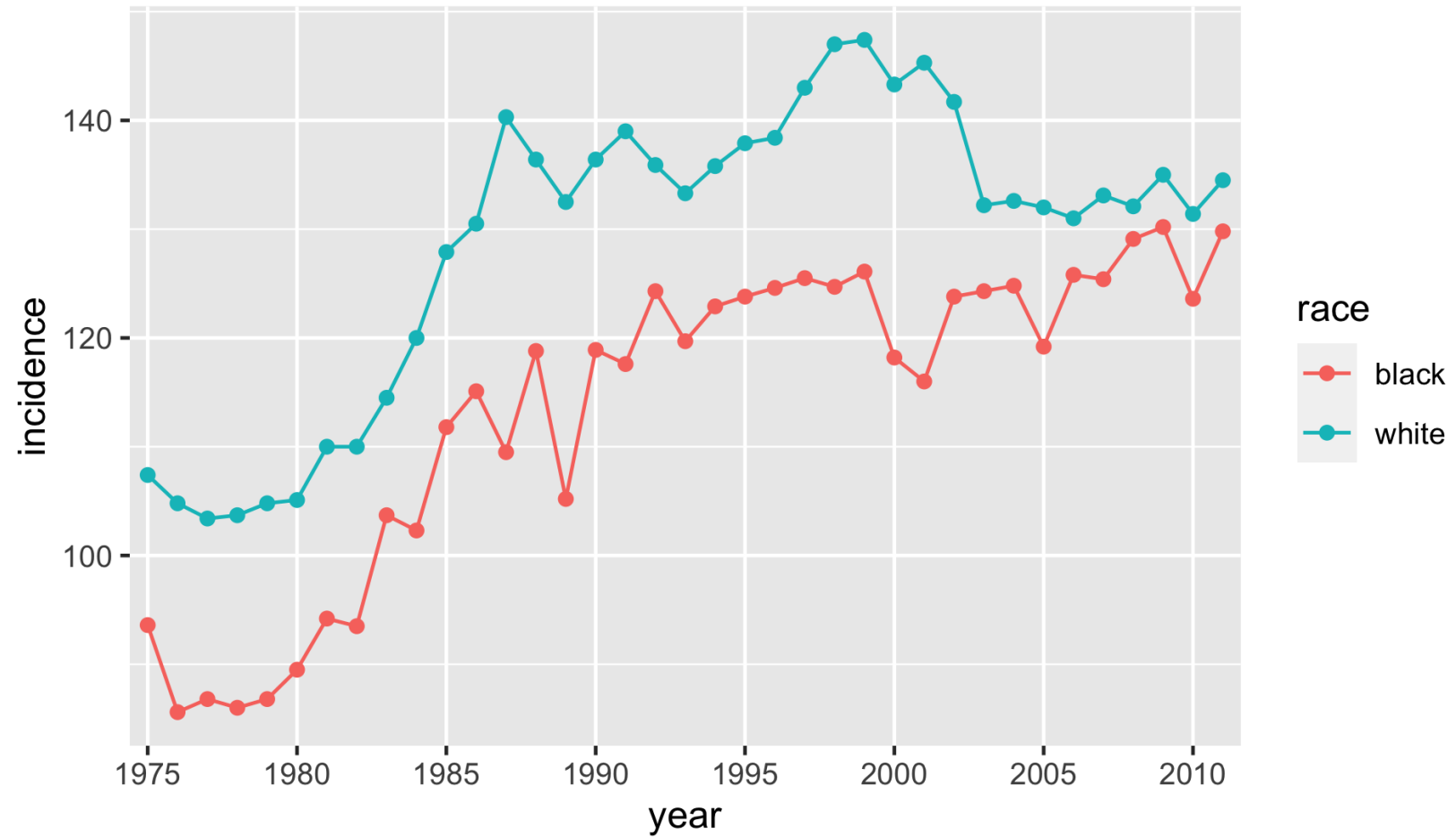
Pivot the columns into 2 new columns called `year` and `incidence`

Add a new variable called `race`. Remember that each data set corresponds to a single race.

Bind the data sets together using `bind_rows()` from the `dplyr` package. Either save it as a new object or pipe the result directly into the `ggplot2` code.

Plot the data using the code below. Fill in the blanks to have `year` on the x-axis, `incidence` on the y-axis, and `race` as the color aesthetic.

Your Turn 5: No solution 😈



Other neat tidyr tools

Uncounting frequency tables

```
lotr %>%  
  pivot_longer(  
    names_to = "sex",  
    values_to = "count",  
    cols = c(female, male)  
  ) %>%  
  uncount(count)
```

Other neat tidyr tools

Uncounting frequency tables

```
## # A tibble: 21,245 x 3
##   film                                race sex
##   <chr>                                <chr> <chr>
## 1 The Fellowship Of The Ring Elf      female
## 2 The Fellowship Of The Ring Elf      female
## 3 The Fellowship Of The Ring Elf      female
## 4 The Fellowship Of The Ring Elf      female
## 5 The Fellowship Of The Ring Elf      female
## 6 The Fellowship Of The Ring Elf      female
## 7 The Fellowship Of The Ring Elf      female
## 8 The Fellowship Of The Ring Elf      female
## 9 The Fellowship Of The Ring Elf      female
## 10 The Fellowship Of The Ring Elf      female
## # ... with 21,235 more rows
```

Other neat tidyr tools

Work with data frames

`crossing()` and `expand()`

`nest()` and `unnest()`

Other neat tidyr tools

Work with missing data

`complete()`

`drop_na()` **and** `replace_na()`

Resources

R for Data Science: A comprehensive but friendly introduction to the tidyverse. Free online.

RStudio Primers: Free interactive courses in the Tidyverse