

Tidy data with tidyr

Day 3 - Introduction to Data Analysis with R

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March 12, 2025

What is tidy data?

What is tidy data?

“**TIDY DATA** is a standard way of mapping the meaning of a dataset to its structure.”

—HADLEY WICKHAM

In tidy data:

- each variable forms a column
- each observation forms a row
- each cell is a single measurement

each column a variable

| id | name | color |
|----|--------|--------|
| 1 | floof | gray |
| 2 | max | black |
| 3 | cat | orange |
| 4 | donut | gray |
| 5 | merlin | black |
| 6 | panda | calico |

each row an observation

Wickham, H. (2014). Tidy Data. Journal of Statistical Software 59 (10). DOI: 10.18637/jss.v059.i10

Illustration from the [Openscapes](#) blog *Tidy Data for reproducibility, efficiency, and collaboration* by Julia Lowndes and Allison Horst

What is tidy data?

Let's look at some examples

Tidy

| id | name | color |
|----|--------|--------|
| 1 | floof | gray |
| 2 | max | black |
| 3 | cat | orange |
| 4 | donut | gray |
| 5 | merlin | black |
| 6 | panda | calico |

Non-tidy

| floof | max | cat | donut | merlin | panda |
|-------|--------|--------|--------|--------|--------|
| gray | black | orange | gray | black | calico |
| gray | black | orange | calico | | |
| floof | max | cat | panda | | |
| donut | merlin | | | | |

Sometimes *raw data* is non-tidy because its structure is optimized for data entry or viewing rather than analysis.

Why tidy data?

The main advantages of **tidy** data is that the **tidyverse** packages are built to work with it.

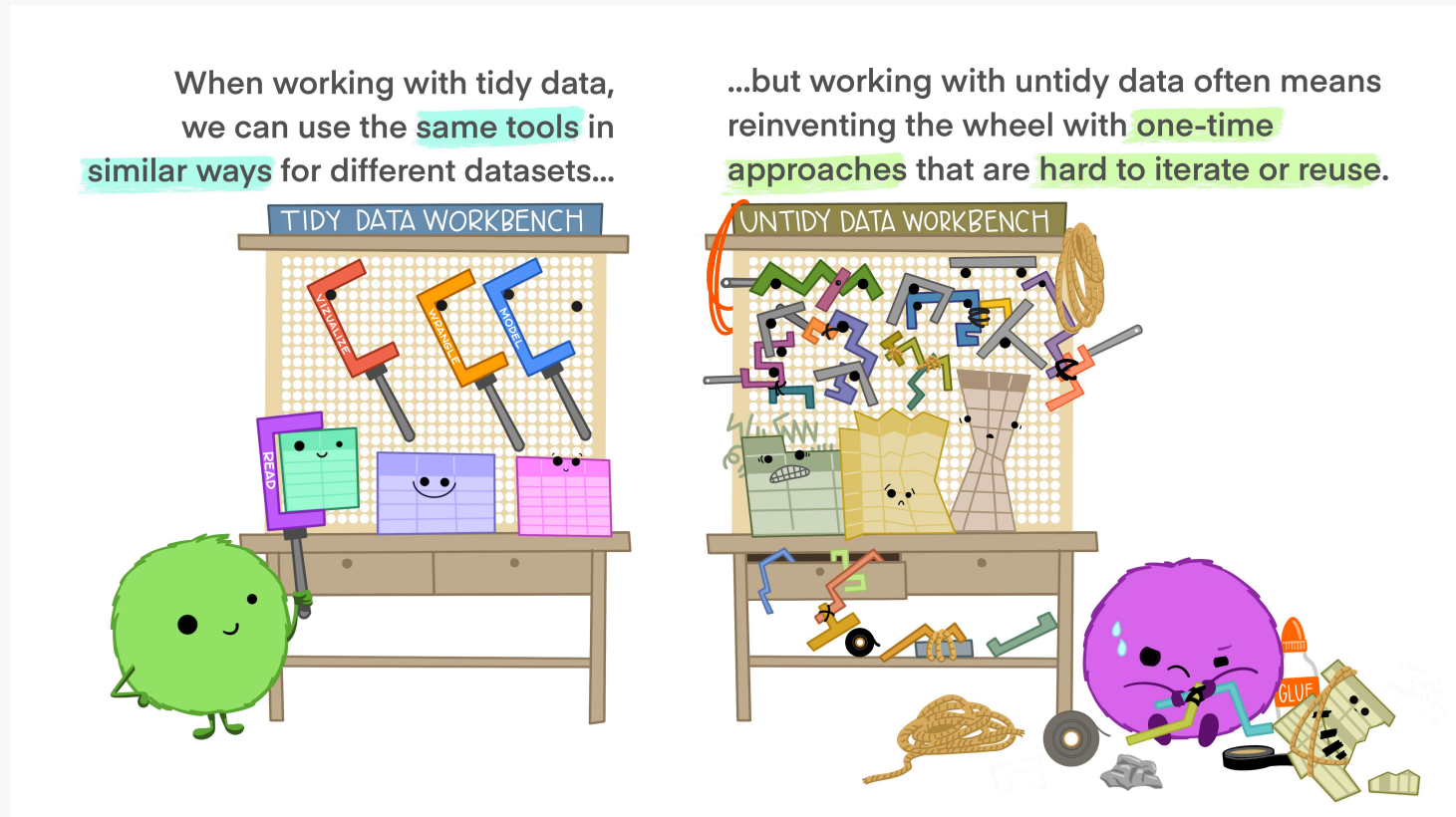


Illustration from the [Openscapes](#) blog *Tidy Data for reproducibility, efficiency, and collaboration* by Julia Lowndes and Allison Horst

Example

Let's go back to the city data set from earlier:

► Expand to reproduce the data

```
cities_tbl
#> # A tibble: 10 × 4
#>   city_name      population_size city_area country
#>   <chr>          <dbl>      <dbl> <chr>
#> 1 Istanbul      15100000      2576 Turkey
#> 2 Moscow         12500000      2561 Russia
#> 3 London          9000000      1572 UK
#> 4 Saint Petersburg 5400000      1439 Russia
#> 5 Berlin          3800000       891 Germany
#> 6 Madrid          3200000       604 Spain
#> 7 Kyiv            3000000       839 Ukraine
#> 8 Rome            2800000      1285 Italy
#> 9 Bucharest       2200000       228 Romania
#> 10 Paris           2100000       105 France
```

This already looks pretty tidy.

Same data different format

- Expand to reproduce the data

```
cities_untidy
#> # A tibble: 2 × 11
#>   type      Turkey_Istanbul Russia_Moscow UK_London Russia_Saint Petersburg...1
#>   <chr>          <dbl>          <dbl>      <dbl>          <dbl>
#> 1 population_size    15100000    12500000    9000000          5400000
#> 2 city_area          2576          2561        1572          1439
#>   Germany_Berlin Spain_Madrid Ukraine_Kyiv Italy_Rome Romania_Bucharest
#>   <dbl>          <dbl>          <dbl>      <dbl>          <dbl>
#> 1    3800000    3200000    3000000    2800000    2200000
#> 2      891      604      839      1285      228
#> # i abbreviated name: 1`Russia_Saint Petersburg`
#> # i 1 more variable: France_Paris <dbl>
```

What's not tidy here?

- Each row has multiple observation
- At the same time, each observation is split across multiple rows
- Country and city variable are split into multiple columns
- Country and city variable values are united to one value

The **tidyr** package

Let's tidy this data using functions from the **tidyr** package!

First load the package with either

```
library(tidyr)
```

or

```
library(tidyverse)
```


pivot_longer()

One variable split into multiple columns can be solved with `pivot_longer`

```
#> # A tibble: 2 × 11
#>   type                Turkey_Istanbul Russia_Moscow UK_London Russia_Saint Petersburg...1
#>   <chr>                <dbl>                <dbl>        <dbl>                <dbl>
#> 1 population_size      15100000      12500000    9000000                5400000
#> 2 city_area            2576                2561        1572                1439
#>   Germany_Berlin Spain_Madrid Ukraine_Kyiv Italy_Rome Romania_Bucharest
#>   <dbl>          <dbl>          <dbl>        <dbl>          <dbl>
#> 1    3800000     3200000     3000000    2800000        2200000
#> 2         891        604         839      1285          228
#> # i abbreviated name: 1`Russia_Saint Petersburg`
#> # i 1 more variable: France_Paris <dbl>
```

pivot_longer()

One variable split into multiple columns can be solved with `pivot_longer`

```
step1 <- pivot_longer(  
  cities_untidy, # the tibble  
  cols = Turkey_Istanbul:France_Paris, # the columns to pivot from:to  
  names_to = "location", # name of the new column  
  values_to = "value"  
) # name of the value column
```

```
#> # A tibble: 20 × 3  
#>   type          location          value  
#>   <chr>         <chr>         <dbl>  
#> 1 population_size Turkey_Istanbul 15100000  
#> 2 population_size Russia_Moscow 12500000  
#> 3 population_size UK_London      9000000  
#> 4 population_size Russia_Saint Petersburg 5400000  
#> # i 16 more rows
```

pivot_longer()

One variable split into multiple columns can be solved with `pivot_longer`

```
step1 <- pivot_longer(  
  cities_untidy, # the tibble  
  cols = Turkey_Istanbul:France_Paris, # the columns to pivot from:to  
  names_to = "location", # name of the new column  
  values_to = "value"  
) # name of the value column
```

Another way to select the columns to pivot:

```
1 step1 <- pivot_longer(  
2   cities_untidy, # the tibble  
3   cols = !type, # All columns except type#<<  
4   names_to = "location", # name of the new column  
5   values_to = "value"  
6 ) # name of the value column
```

separate_wider_delim()

Multiple variable values that are united into one can be separated using `separate_wider_delim`

```
#> # A tibble: 20 × 3
#>   type      location      value
#>   <chr>      <chr>      <dbl>
#> 1 population_size Turkey_Istanbul 15100000
#> 2 population_size Russia_Moscow   12500000
#> # i 18 more rows
```

```
step2 <- separate_wider_delim(
  step1, # the tibble
  location, # the column to separate
  delim = "_", # the separator
  names = c("country", "city_name")
) # names of new columns
```

```
#> # A tibble: 20 × 4
#>   type      country city_name      value
#>   <chr>      <chr>   <chr>      <dbl>
#> 1 population_size Turkey   Istanbul 15100000
#> 2 population_size Russia   Moscow    12500000
#> # i 18 more rows
```

The opposite function exists as well and is called `unite`. Check out `?unite` for details.

pivot_wider()

One observation split into multiple rows can be solved with `pivot_wider`

```
#> # A tibble: 20 × 4
#>   type          country city_name    value
#>   <chr>         <chr>   <chr>      <dbl>
#> 1 population_size Turkey   Istanbul 15100000
#> 2 population_size Russia   Moscow    12500000
#> # i 18 more rows
```

```
step3 <- pivot_wider(
  step2, # the tibble
  names_from = type, # the variables
  values_from = value
) # the values
```

```
#> # A tibble: 10 × 4
#>   country city_name    population_size city_area
#>   <chr>   <chr>          <dbl>      <dbl>
#> 1 Turkey Istanbul      15100000      2576
#> 2 Russia Moscow        12500000      2561
#> 3 UK      London          9000000      1572
#> 4 Russia Saint Petersburg 5400000      1439
#> 5 Germany Berlin        3800000       891
#> # i 5 more rows
```

All steps in 1

We can also use a pipe to do all these steps in one:

```
cities_tidy <- cities_untidy |>
  pivot_longer(
    Turkey_Istanbul:France_Paris,
    names_to = "location",
    values_to = "values"
  ) |>
  separate_wider_delim(
    location,
    delim = "_",
    names = c("country", "city_name")
  ) |>
  pivot_wider(
    names_from = type,
    values_from = values
  )
```

Remove missing values with `drop_na()`

Drop rows with missing values:

```
# drop rows with missing values in any column
drop_na(and_vertebrates)
# drop rows with missing values in weight column
drop_na(and_vertebrates, weight_g)
# drop rows with missing values in weight and species columns
drop_na(and_vertebrates, weight_g, species)
```

This is an easier and more intuitive alternative to `filter(!is.na(...))`.

Now you

Task (30 min)

Tidy data with tidyr

Find the task description [here](#)