Tidy data with tidyr (basics)

Outline

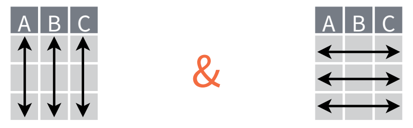
The tidyr package and tidy data review

Functions

- Important ones: pivot_wider(), pivot_longer(), and friends
- Others that might be of some use!

Data tidying with tidyr : : CHEAT SHEET

Tidy data is a way to organize tabular data in a consistent data structure across packages.
A table is tidy if:



Each **variable** is in its own **column**

Each **observation**, or **case**, is in its own row

Access **variables** as **vectors**

Preserve **cases** in vectorized operations

Tibbles

AN ENHANCED DATA FRAME

Tibbles are a table format provided by the **tibble** package. They inherit the data frame class, but have improved behaviors:

- **Subset** a new tibble with], a vector with [[and $.
- **No partial matching** when subsetting columns.
- **Display** concise views of the data on one screen.

options(tibble.print_max = n, tibble.print_min = m, tibble.width = Inf**)** Control default display settings.

View() or **glimpse()** View the entire data set.

CONSTRUCT A TIBBLE

tibble(…**)** Construct by columns.
tibble(x = 1:3, y = c("a", "b", "c"))

tribble(…**)** Construct by rows.
tribble(~x, ~y,
1, "a",
2, "b",
3, "c")

Both make this tibble

```
A tibble: 3 × 2
      x     y
  <int> <chr>
1     1     a
2     2     b
3     3     c
```

as_tibble(x, …**)** Convert a data frame to a tibble.

enframe(x, name = "name", value = "value"**)** Convert a named vector to a tibble. Also **deframe()**.

is_tibble(x**)** Test whether x is a tibble.

Reshape Data

- Pivot data to reorganize values into a new layout.

table4a

country	1999	2000
A	0.7K	2K
B	37K	80K
C	212K	213K

→

country	year	cases
A	1999	0.7K
B	1999	37K
C	1999	212K
A	2000	2K
B	2000	80K
C	2000	213K

pivot_longer(data, cols, names_to = "name", values_to = "value", values_drop_na = FALSE**)**

"Lengthen" data by collapsing several columns into two. Column names move to a new names_to column and values to a new values_to column.

pivot_longer(table4a, cols = 2:3, names_to ="year", values_to = "cases")

table2

country	year	type	count
A	1999	cases	0.7K
A	1999	pop	19M
A	2000	cases	2K
A	2000	pop	20M
B	1999	cases	37K
B	1999	pop	172M
B	2000	cases	80K
B	2000	pop	174M
C	1999	cases	212K
C	1999	pop	1T
C	2000	cases	213K
C	2000	pop	1T

→

country	year	cases	pop
A	1999	0.7K	19M
A	2000	2K	20M
B	1999	37K	172M
B	2000	80K	174M
C	1999	212K	1T
C	2000	213K	1T

pivot_wider(data, names_from = "name", values_from = "value"**)**

The inverse of pivot_longer(). "Widen" data by expanding two columns into several. One column provides the new column names, the other the values.

pivot_wider(table2, names_from = type, values_from = count)

Split Cells

- Use these functions to split or combine cells into individual, isolated values.

table5

country	century	year
A	19	99
A	20	00
B	19	99
B	20	00

→

country	year
A	1999
A	2000
B	1999
B	2000

unite(data, col, …, sep = "_", remove = TRUE, na.rm = FALSE**)** Collapse cells across several columns into a single column.

unite(table5, century, year, col = "year", sep = "")

table3

country	year	rate
A	1999	0.7K/19M
A	2000	2K/20M
B	1999	37K/172M
B	2000	80K/174M

→

country	year	cases	pop
A	1999	0.7K	19M
A	2000	2K	20M
B	1999	37K	172
B	2000	80K	174

separate(data, col, into, sep = "[^[:alnum:]]+", remove = TRUE, convert = FALSE, extra = "warn", fill = "warn", …**)** Separate each cell in a column into several columns. Also **extract()**.

separate(table3, rate, sep = "/", into = c("cases", "pop"))

table3

country	year	rate
A	1999	0.7K/19M
A	2000	2K/20M
B	1999	37K/172M
B	2000	80K/174M

→

country	year	rate
A	1999	0.7K
A	1999	19M
A	2000	2K
A	2000	20M
B	1999	37K
B	1999	172M
B	2000	80K
B	2000	174M

separate_rows(data, …, sep = "[^[:alnum:].]+", convert = FALSE**)** Separate each cell in a column into several rows.

separate_rows(table3, rate, sep = "/")

Expand Tables

Create new combinations of variables or identify implicit missing values (combinations of variables not present in the data).

x

x1	x2	x3
A	1	3
B	1	4
B	2	3

→

x1	x2
A	1
A	2
B	1
B	2

expand(data, …**)** Create a new tibble with all possible combinations of the values of the variables listed in … Drop other variables.
expand(mtcars, cyl, gear, carb)

x

x1	x2	x3
A	1	3
B	1	4
B	2	3

→

x1	x2	x3
A	1	3
A	2	NA
B	1	4
B	2	3

complete(data, …, fill = list()**)** Add missing possible combinations of values of variables listed in … Fill remaining variables with NA.
complete(mtcars, cyl, gear, carb)

Handle Missing Values

Drop or replace explicit missing values (NA).

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

→

x1	x2
A	1
D	3

drop_na(data, …**)** Drop rows containing NA's in … columns.
drop_na(x, x2)

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

→

x1	x2
A	1
B	1
C	1
D	3
E	3

fill(data, …, .direction = "down"**)** Fill in NA's in … columns using the next or previous value.
fill(x, x2)

x

x1	x2
A	1
B	NA
C	NA
D	3
E	NA

→

x1	x2
A	1
B	2
C	2
D	3
E	2

replace_na(data, replace**)** Specify a value to replace NA in selected columns.
replace_na(x, list(x2 = 2))

tidyr

The *tidyr* package is a part of the *tidyverse* and is the main function for tidying data

Tidy data principles:

1. Every column is a variable
2. Every row is an observation
3. Every cell is a single value

There are five main actions/categories that *tidyr* addresses

1. Pivotting
2. Rectangling
3. Nesting
4. Splitting
5. Implicit/Explicit

Pivotting Data

There are many circumstances in which you need to change the shape of the data

I've encountered it most often in plotting, but it happens elsewhere!

Example:

```
 name    hw1 hw2 hw3 test1 test2
"John"   60  89  93   85    89
"Mary"   89  93  75   90    82
"Ben"    76  98  83   87    76
"Steph"  88  81  87   90    95
```

I want to plot how the students did over time/assignment with one point per student. How do I do that?

pivot_longer()

pivot_longer() takes data in a “wide” format and gathers the data into a long format.

Now the third iteration of the same function: melt(), gather(), pivot_longer()

pivot_longer()

```
pivot_longer(
 data,
 cols,
 names_to = "name",
 names_prefix = NULL,
 names_sep = NULL,
 names_pattern = NULL,
 names_ptypes = list(),
 names_repair = “check_unique",
 values_to = "value",
 values_drop_na = FALSE,
 values_ptypes = list()
)
```

The data to be pivoted

The columns to pivot into longer format

Name of the column where variable names go

Name of the column where values go

pivot_longer()

```r
tb %>%
  pivot_longer(-name,
               names_to = "assignment",
               values_to = "grade")
```

tb

name	hw1	hw2	hw3	test1	test2
"John"	60	89	93	85	89
"Mary"	89	93	75	90	82
"Ben"	76	98	83	87	76
"Steph"	88	81	87	90	95

```
# A tibble: 20 x 3
   name  assignment grade
   <chr> <chr>      <dbl>
 1 John  hw1           60
 2 John  hw2           89
 3 John  hw3           93
 4 John  test1         85
 5 John  test2         89
 6 Mary  hw1           89
 7 Mary  hw2           93
 8 Mary  hw3           75
 9 Mary  test1         90
10 Mary  test2         82
11 Ben   hw1           76
12 Ben   hw2           98
13 Ben   hw3           83
14 Ben   test1         87
15 Ben   test2         76
16 Steph hw1           88
17 Steph hw2           81
18 Steph hw3           87
19 Steph test1         90
20 Steph test2         95
```

Your Turn!

The tidyr package has a dataset called *relig_income*

I want you to pivot the data longer so that each count (cell of the table) gets its own separate row. Make the names column (previous column names) called "income" and make the values column called "count"

pivot_wider()

pivot_wider() takes data in a “long” format and spreads the data into a wide format.

Now the third iteration of the same function: dcast(), spread(), pivot_wider()

It is the inverse of pivot_longer()

To see how it works, let’s take the data back to its original form!

pivot_wider()

```
tb2
```

```
# A tibble: 20 x 3
   name  assignment grade
   <chr> <chr>      <dbl>
 1 John  hw1           60
 2 John  hw2           89
 3 John  hw3           93
 4 John  test1         85
 5 John  test2         89
 6 Mary  hw1           89
 7 Mary  hw2           93
 8 Mary  hw3           75
 9 Mary  test1         90
10 Mary  test2         82
11 Ben   hw1           76
12 Ben   hw2           98
13 Ben   hw3           83
14 Ben   test1         87
15 Ben   test2         76
16 Steph hw1           88
17 Steph hw2           81
18 Steph hw3           87
19 Steph test1         90
20 Steph test2         95
```

```
tb2 %>%
  pivot_wider(names_from = assignment,
                          values_from = grade)
```

```
# A tibble: 4 x 6
  name    hw1   hw2   hw3 test1 test2
  <chr> <dbl> <dbl> <dbl> <dbl> <dbl>
1 John     60    89    93    85    89
2 Mary     89    93    75    90    82
3 Ben      76    98    83    87    76
4 Steph    88    81    87    90    95
```

Your Turn!

The tidyr package has a dataset called *fish_encounters*

I want you to pivot the data wider that the new names come from the “station” column and the new values come from the “seen” column

More Examples!

Let’s look at other specifications and datasets here

hoist() and unnest() variants

hoist(), unnest_longer(), and unnest_wider() are variants that provide tools for rectangling or collapsing deeply nested lists into tidy tibbles

```
df <- tibble(
    character = c("Toothless", "Dory"),
    metadata = list(
        list(
            species = "dragon",
            color = "black",
            films = c(
                "How to Train Your Dragon",
                "How to Train Your Dragon 2",
                "How to Train Your Dragon: The Hidden World"
            )
        ),
        list(
            species = "blue tang",
            color = "blue",
            films = c("Finding Nemo", "Finding Dory")
        )
    )
)
```

```
df %>% unnest_wider(metadata)
```

```
# A tibble: 2 × 4
  character species   color films
  <chr>     <chr>     <chr> <list>
1 Toothless dragon    black <chr [3]>
2 Dory      blue tang blue  <chr [2]>
```

hoist() and unnest() variants

```
df %>% hoist(metadata,
             "species",
             first_film = list("films", 1L),
             third_film = list("films", 3L)
)
```

```
# A tibble: 2 × 5
  character species    first_film               third_film               metadata
  <chr>     <chr>      <chr>                    <chr>                    <list>
1 Toothless dragon     How to Train Your Dragon How to Train Your Dr… <named li…
2 Dory      blue tang  Finding Nemo             NA                       <named li…
```

nest()

Opposite of the hoist() and unnest() options! Can nest smaller data frames in larger ones

```r
df <- tibble(x = c(1, 1, 1, 2, 2, 3), y = 1:6, z = 6:1)
```

```r
df %>% nest(data = c(y, z))
```

```
# A tibble: 3 × 2
      x data
  <dbl> <list>
1     1 <tibble [3 × 2]>
2     2 <tibble [2 × 2]>
3     3 <tibble [1 × 2]>
```