R08: Transforming and subetting data with `tidyverse`

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Introduction to the `tidyverse`

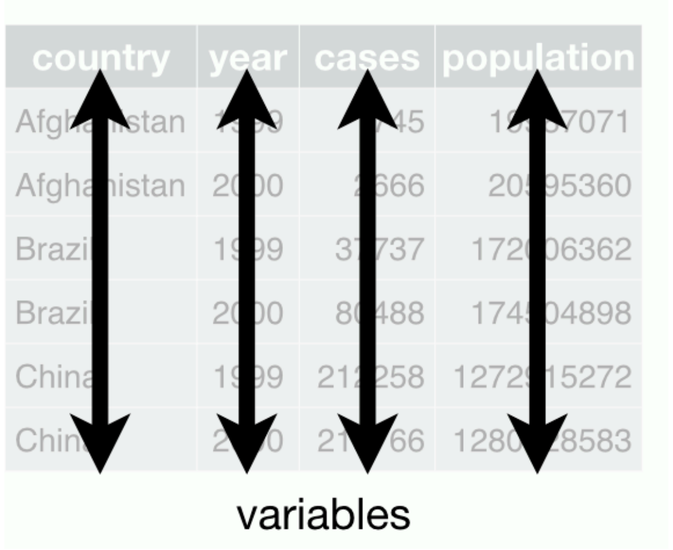

SPIDER-MAN
INTO THE SPIDER-VERSE

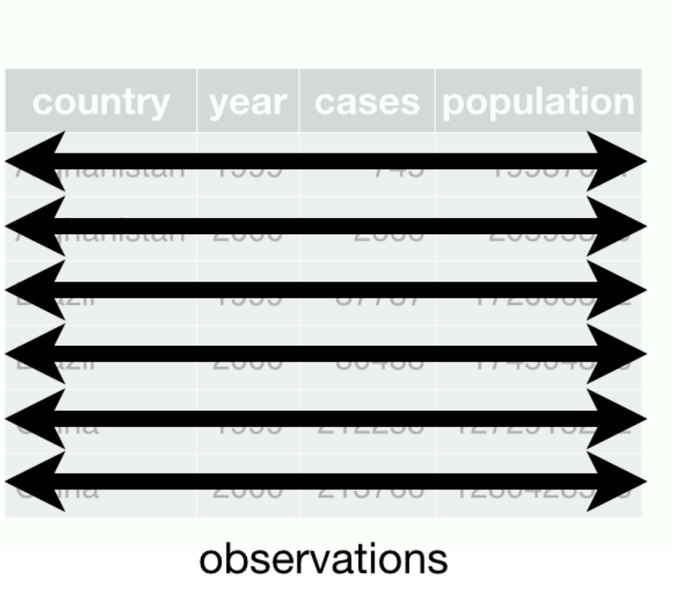
What is the tidyverse?

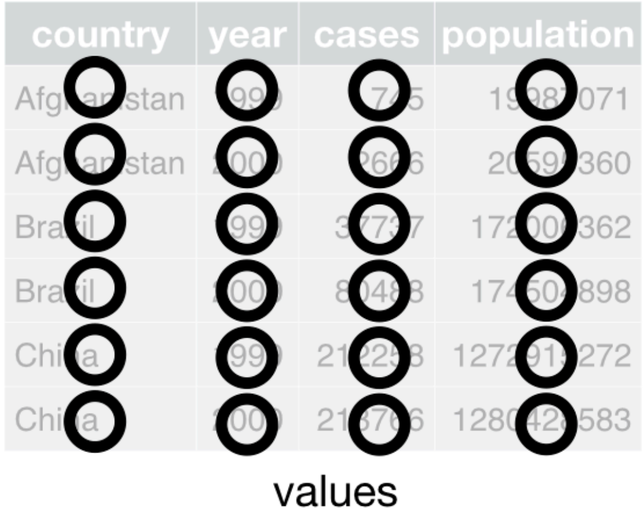
The **tidyverse** is a collection of R packages designed for data science. All packages share an underlying design philosophy, grammar, and data structures.

- **ggplot2** - data visualisation
- **dplyr** - data manipulation
- **tidyr** - tidy data
- **readr** - read rectangular data
- **purrr** - functional programming
- **tibble** - modern data frames
- **stringr** - string manipulation
- **forcats** - factors
- and many more …

Tidy data[1]







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

Pipe operator (`magrittr`)

- The pipe operator (`%>%`) allows us to step through sequential functions in the same way we follow if-then statements or steps from instructions

I want to find my keys, then start my car, then drive to work, then park my car.

Nested

```
park(drive(start_car(find("keys")),
           to = "work"))
```

Piped

```
find("keys") %>%
  start_car() %>%
  drive(to = "work") %>%
  park()
```

Helpful functions for transforming and subsetting

Helpful functions for transforming and subsetting

Data transformation

- `rename()`
- `mutate()`
- `pivot_longer()` and `pivot_wider()`

Data subsetting

- `filter()`
- `select()`

New dataset: `dds.discr`

- In the US, individuals with developmental disabilities typically receive services and support from state governments
  - California allocates funds to developmentally disabled residents through the Department of Developmental Services (DDS)
- Dataset `dds.discr`
  - Sample of 1,000 people who received DDS funds (out of a total of ~ 250,000)
  - Data include age, sex, race/ethnicity, and annual DDS financial support per consumer

Let's look back at the `dds.discr` dataset

- We will load the data (This is a special case! `dds.discr` is a built-in R dataset)

```
1 data("dds.discr")
```

- Now, let's take a glimpse at the dataset:

```
1 glimpse(dds.discr)
```

```
Rows: 1,000
Columns: 6
$ id           <int> 10210, 10409, 10486, 10538, 10568, 10690, 10711, 10778, 1…
$ age.cohort   <fct> 13-17, 22-50, 0-5, 18-21, 13-17, 13-17, 13-17, 13-17, 13-…
$ age          <int> 17, 37, 3, 19, 13, 15, 13, 17, 14, 13, 13, 14, 15, 17, 20…
$ gender       <fct> Female, Male, Male, Female, Male, Female, Female, Male, F…
$ expenditures <int> 2113, 41924, 1454, 6400, 4412, 4566, 3915, 3873, 5021, 28…
$ ethnicity    <fct> White not Hispanic, White not Hispanic, Hispanic, Hispani…
```

Helpful functions for transforming and subsetting

Data transformation

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- `mutate()`
- `pivot_longer()` and `pivot_wider()`

Data subsetting

- `filter()`
- `select()`

`rename()`: one of the first things I usually do

- I notice that two variables have values that don't necessarily match the variable name
  - Female and male are not genders (NIH page on sex and gender)
  - "White not Hispanic" combines race and ethnicity into one category (APA page on race and ethnicity)

I want to rename gender to sex (not sure if assigned at birth or current sex) and rename ethnicity to R_E (race and ethnicity)

`rename()`: one of the first things I usually do

- `rename()` can change the name of a column
- We use: `data %>% rename(new_col_name = old_col_name)`

```
1 dds.discr1 = dds.discr %>%
2   rename(SAB = gender,
3          R_E = ethnicity)
4
5 glimpse(dds.discr1)
```

```
Rows: 1,000
Columns: 6
$ id           <int> 10210, 10409, 10486, 10538, 10568, 10690, 10711, 10778, 1…
$ age.cohort   <fct> 13-17, 22-50, 0-5, 18-21, 13-17, 13-17, 13-17, 13-17, 13-…
$ age          <int> 17, 37, 3, 19, 13, 15, 13, 17, 14, 13, 13, 14, 15, 17, 20…
$ SAB          <fct> Female, Male, Male, Female, Male, Female, Female, Male, F…
$ expenditures <int> 2113, 41924, 1454, 6400, 4412, 4566, 3915, 3873, 5021, 28…
$ R_E          <fct> White not Hispanic, White not Hispanic, Hispanic, Hispani…
```

Helpful functions for transforming and subsetting

Data transformation

- `rename()`
- `mutate()`
- `pivot_longer()` and `pivot_wider()`

Data subsetting

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- `select()`

`mutate()`: constructing new variables from what you have

- We can create a new variable from other variables
  - Another way to say it: creates new columns that are functions of existing variables
- We often use it like:

```
data %>% mutate(new_variable = some_transformation_of_another_variable)
```

`mutate()`: create a new variable from two other variables

I want to make a variable that is the ratio of expenditures over age

```
1 dds.discr2 = dds.discr1 %>%
2   mutate(exp_to_age = expenditures/age)
3
4 glimpse(dds.discr2)
```

```
Rows: 1,000
Columns: 7
$ id           <int> 10210, 10409, 10486, 10538, 10568, 10690, 10711, 10778, 1…
$ age.cohort   <fct> 13-17, 22-50, 0-5, 18-21, 13-17, 13-17, 13-17, 13-17, 13-…
$ age          <int> 17, 37, 3, 19, 13, 15, 13, 17, 14, 13, 13, 14, 15, 17, 20…
$ SAB          <fct> Female, Male, Male, Female, Male, Female, Female, Male, F…
$ expenditures <int> 2113, 41924, 1454, 6400, 4412, 4566, 3915, 3873, 5021, 28…
$ R_E          <fct> White not Hispanic, White not Hispanic, Hispanic, Hispani…
$ exp_to_age   <dbl> 124.2941, 1133.0811, 484.6667, 336.8421, 339.3846, 304.40…
```

Recoding a numeric variable into categorical

Can we recreate `age.cohort` using the `age` varible?

```
1 summary(dds.discr2)
```

```
       id          age.cohort        age             SAB        expenditures
 Min.   :10210   0-5  : 82   Min.   : 0.0   Female:503   Min.   :  222
 1st Qu.:31809   6-12 :175   1st Qu.:12.0   Male  :497   1st Qu.: 2899
 Median :55384   13-17:212   Median :18.0                Median : 7026
 Mean   :54663   18-21:199   Mean   :22.8                Mean   :18066
 3rd Qu.:76135   22-50:226   3rd Qu.:26.0                3rd Qu.:37713
 Max.   :99898   51+  :106   Max.   :95.0                Max.   :75098

                    R_E         exp_to_age
 White not Hispanic:401   Min.   : 27.57
 Hispanic           :376   1st Qu.:273.88
 Asian              :129   Median :461.75
 Black              : 59   Mean   :   Inf
 Multi Race         : 26   3rd Qu.:938.12
 American Indian    :  4   Max.   :   Inf
 (Other)            :  5
```

Recoding a numeric variable into categorical (2/2)

- We can integrate other functions into `mutate()`
- For example, `case_when()` is a helpful function for mapping values to a category

Tidyverse:

```
dds.discr3 <- dds.discr2 %>%
  mutate(
    age.cohort2 = case_when(
          age <= 5 ~ "0-5",
          age <= 12 ~ "6-12",
          age <= 17 ~ "13-17",
          age <= 21 ~ "18-21",
          age <= 50 ~ "22-50",
          age >= 51 ~ "51+"
    )
  )
```

Have you noticed that I change the number on `dds.discr`?

- I change the number so that R saves a new dataset
- And I do not overwrite the previous dataset
- Can be annoying, but VERY helpful when you have to go back and change code
- When you run things in real time and troubleshoot, it will be helpful to have different versions of the same dataframe

Helpful functions for transforming and subsetting

Data transformation

- `rename()`
- `mutate()`
- `pivot_longer()` and `pivot_wider()`

Data subsetting

- `filter()`
- `select()`

`filter()`: keep rows that match a condition

- What if I want to subset the data frame? (keep certain rows of observations)

I want to look at the data for people who between 50 and 60 years old

```
1 dds.discr4 = dds.discr3 %>%
2   filter(age >= 50 & age <= 60)
3
4 glimpse(dds.discr4)
```

```
Rows: 23
Columns: 8
$ id           <int> 15970, 19412, 29506, 31658, 36123, 39287, 39672, 43455, 4…
$ age.cohort   <fct> 51+, 51+, 51+, 51+, 51+, 51+, 51+, 51+, 51+, 51+, 51+, 51…
$ age          <int> 51, 60, 56, 60, 59, 59, 54, 57, 52, 57, 55, 52, 59, 54, 5…
$ SAB          <fct> Female, Female, Female, Female, Male, Female, Female, Mal…
$ expenditures <int> 54267, 57702, 48215, 46873, 42739, 44734, 52833, 48363, 5…
$ R_E          <fct> White not Hispanic, White not Hispanic, White not Hispani…
$ exp_to_age   <dbl> 1064.0588, 961.7000, 860.9821, 781.2167, 724.3898, 758.20…
$ age.cohort2  <chr> "51+", "51+", "51+", "51+", "51+", "51+", "51+", "51+", "…
```

Helpful functions for transforming and subsetting

Data transformation

- `rename()`
- `mutate()`
- `pivot_longer()` and `pivot_wider()`

Data subsetting

- `filter()`
- `select()`

`select()`: keep or drop columns using their names and types

- What if I want to remove or keep certain variables?

I want to only have age and expenditure in my data frame

```
1 dds.discr5 = dds.discr2 %>%
2   select(age, expenditures)
3
4 glimpse(dds.discr5)
```

```
Rows: 1,000
Columns: 2
$ age          <int> 17, 37, 3, 19, 13, 15, 13, 17, 14, 13, 13, 14, 15, 17, 20…
$ expenditures <int> 2113, 41924, 1454, 6400, 4412, 4566, 3915, 3873, 5021, 28…
```

Resources

`dplyr` resources

- More `dpylr` functions to reference!

Additional details and examples are available in the vignettes:

- column-wise operations vignette
- row-wise operations vignette

and the dplyr 1.0.0 release blog posts:

- working across columns
- working within rows

R programming class at OHSU!

You can check out Dr. Jessica Minnier's R class page if you want more notes, videos, etc.

The larger tidy ecosystem

Just to name a few…

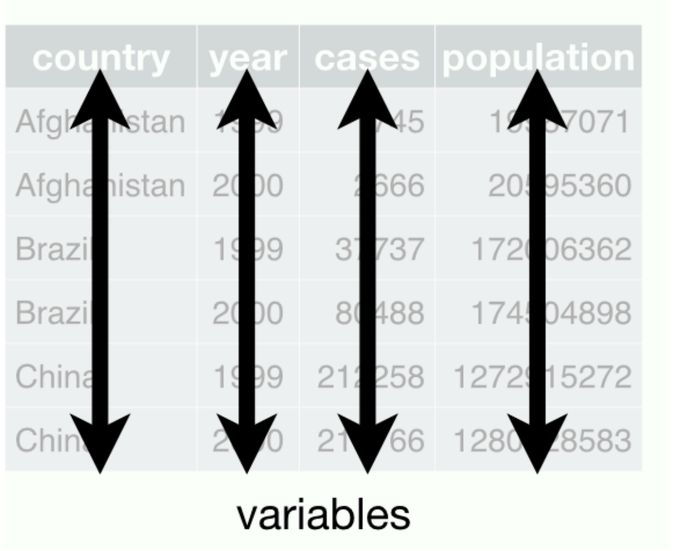
- janitor
- kableExtra
- patchwork
- gghighlight
- tidybayes

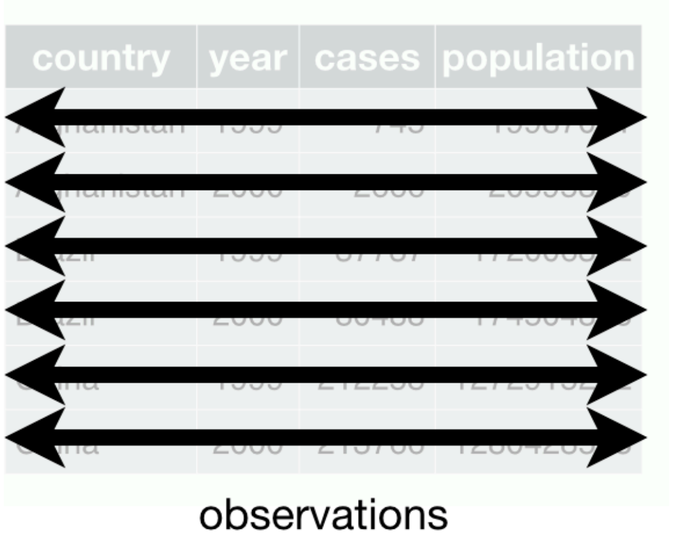
Credit to Mine Çetinkaya-Rundel

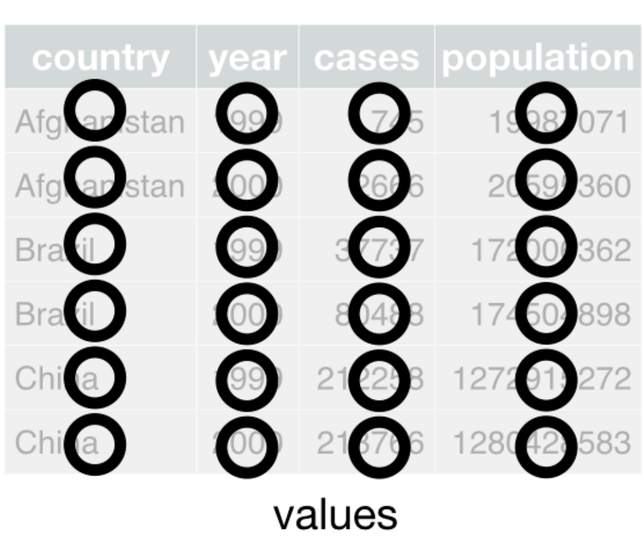
- These notes were built from Mine's notes
  - Most pages and code were left as she made them
  - I changed a few things to match our class
- Please see her Github repository for the original notes

If time

Tidy data[1]







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

How do we make our data tidy??

- From a contingency table, we need to create the dataframe using the counts

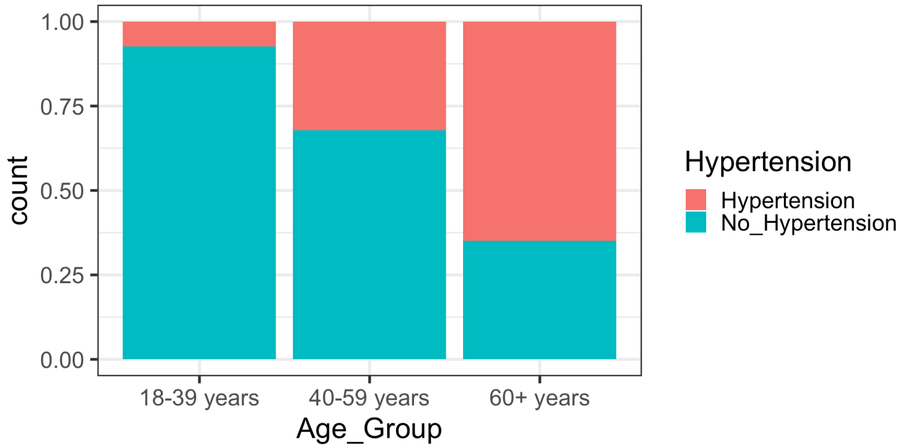
- In Lesson 4, we saw this contingency table:

Table: Contingency table showing hypertension status and age group, in thousands.

Age Group	Hypertension	No Hypertension
18-39 yrs	8836	112206
40-59 yrs	42109	88663
60+ yrs	39917	21589

- And then I magically had it in a new format so I could make this plot:

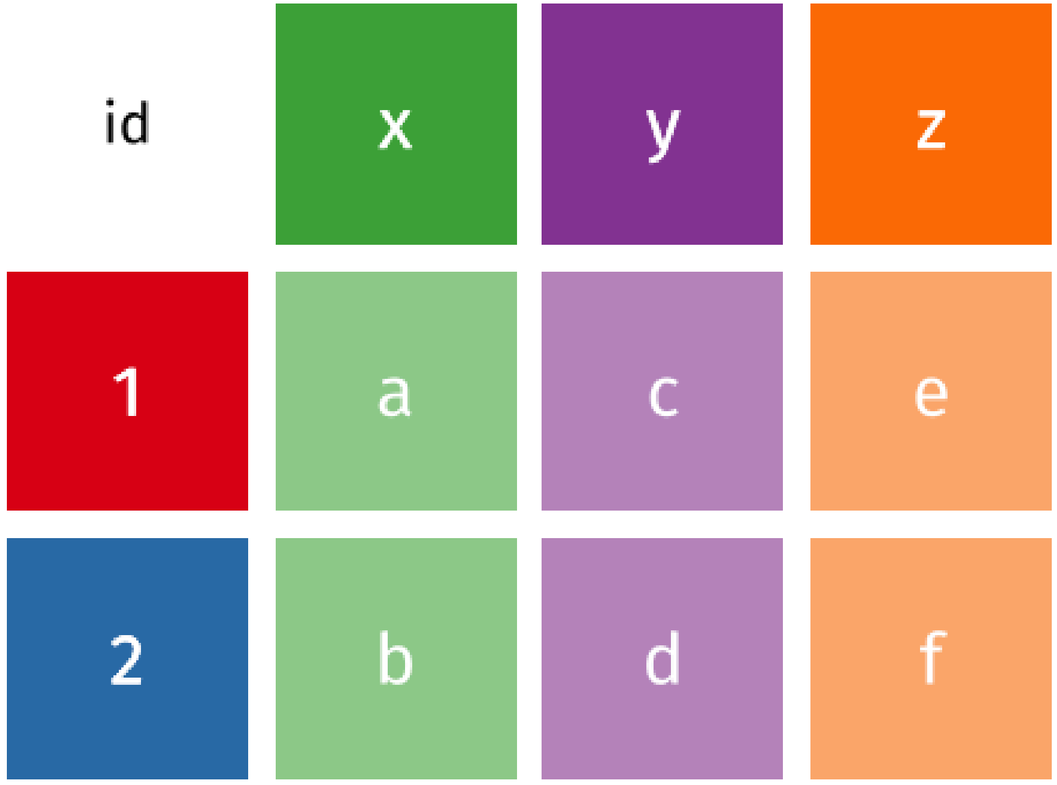
▶ Code




PIVOT!!!

`pivot_*()` functions

wide



I used `pivot_longer()` to create tidy data (1/2)

- Note that you won't be required to use `pivot_longer()`
  - I will give you data in a tidy form
- Here's the original data frame:

```
hyp_cont <- data.frame(
  Age_Group = c("18-39 years", "40-59 years", "60+ years"),
  Hypertension = c(8836, 42109, 39917),
  No_Hypertension = c(112206, 88663, 21589) )
```

- Note that I use use `data.frame()` to make a data frame
- Then I can name each column that we saw in the contingency table
- Note that information about hypertension vs no hypertension is split between columns
  - And that we only have 3 rows of data to show all 313320 observations

I used `pivot_longer()` to create tidy data (2/2)

We need to tell `pivot_longer()`:

- Which column must be repeated (pivoted) (all other columns are not repeating)
- The name of the new column that will contain the old variable names
- Where the values in each cell under the old variables will go

```
hyp_data1 = pivot_longer(
              data = hyp_cont,
              cols = -Age_Group,          # columns to pivot
              names_to = "Hypertension", # name of new column for variable names
              values_to = "Counts")      # name of new column for values
hyp_data1
```

```
# A tibble: 6 × 3
  Age_Group   Hypertension    Counts
  <chr>       <chr>            <dbl>
1 18-39 years Hypertension      8836
2 18-39 years No_Hypertension 112206
3 40-59 years Hypertension     42109
4 40-59 years No_Hypertension  88663
5 60+ years   Hypertension     39917
6 60+ years   No_Hypertension  21589
```

One more step to make it tidy

- Aka we need one more step to make it so every row is an observation
  - In this case, we want each row to represent data from one person

```
hyp_data = hyp_data1 %>% uncount(Counts)
head(hyp_data, 10)
```

```
# A tibble: 10 × 2
   Age_Group   Hypertension
   <chr>       <chr>
 1 18-39 years Hypertension
 2 18-39 years Hypertension
 3 18-39 years Hypertension
 4 18-39 years Hypertension
 5 18-39 years Hypertension
 6 18-39 years Hypertension
 7 18-39 years Hypertension
 8 18-39 years Hypertension
 9 18-39 years Hypertension
10 18-39 years Hypertension
```