STATS 220

Data wrangling🛠️

Let's talk about code readability again!

- looooooooooooooooong!

```
show_up_to_work(have_breakfast(glam_up(dress(shower(wake_up("I"))))))
```

- infinite nesting.....

```
show_up_to_work(
  have_breakfast(
    glam_up(
      dress(
        shower(
          wake_up("I")
        )
      )
    )
  )
)
```


Does this one look better?

```
morning1 <- wake_up("I")
morning2 <- shower(morning1)
morning3 <- dress(morning2)
morning4 <- glam_up(morning3)
morning5 <- have_breakfast(morning4)
morning6 <- show_up_to_work(morning5)
```

- ✗ many intermediate steps
- ✗ not meaningful variable names

How about this one?

```
morning_routine <- "I" %>%
  wake_up() %>%
  shower() %>%
  dress() %>%
  glam_up() %>%
  have_breakfast() %>%
  show_up_to_work()
```

- ✓ %>% for expressing a **linear** sequence of multiple operations

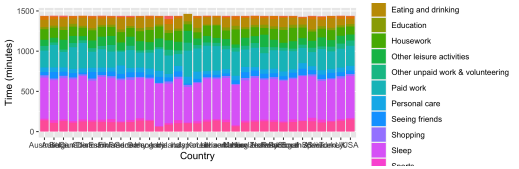
RStudio shortcut: Ctrl/Cmd + Shift + M

Time use in OECD: 🛌🌮👨‍🎓🙆

```
library(readxl)
library(tidyverse)
time_use_raw <- read_xlsx("data/time-use-oecd.xlsx")
time_use_raw
```

```
#> # A tibble: 461 x 3
#>   Country   Category  `Time (minutes)`
#>   <chr>     <chr>                <dbl>
#> 1 Australia Paid work              211.
#> 2 Austria   Paid work              280.
#> 3 Belgium   Paid work              194.
#> 4 Canada    Paid work              269.
#> 5 Denmark   Paid work              200.
#> 6 Estonia   Paid work              231.
#> # … with 455 more rows
```

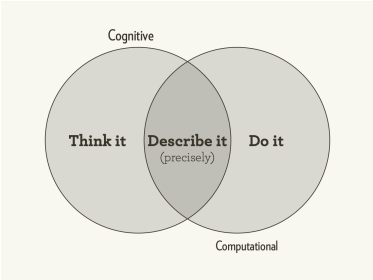

Pipe the input into the first argument in the function




```
ggplot(time_use_raw) +
  geom_col(aes(
    Country, `Time (minutes)`,
    fill = Category))
```

```
time_use_raw %>%
  ggplot() +
  geom_col(aes(
    Country, `Time (minutes)`,
    fill = Category))
```


Expressing yourself in R



Hadley Wickham: Expressing yourself in R

{dplyr} is a grammar of data manipulation, providing a consistent set of **verbs** that help you solve the most common data manipulation challenges:

1. `mutate()` adds new variables that are functions of existing variables
2. `select()` picks variables based on their names.
3. `filter()` picks cases based on their values.
4. `summarise()` reduces multiple values down to a single summary.
5. `arrange()` changes the ordering of the rows.

These all combine naturally with `group_by()` which allows you to perform any operation “by group”.

One table verbs 🔨

Rename columns

```
time_use <- time_use_raw %>%
  rename( # new_name = old_name
    country = Country,
    category = Category,
    minutes = `Time (minutes)`)
time_use
```

```
#> # A tibble: 461 x 3
#>   country   category  minutes
#>   <chr>     <chr>       <dbl>
#> 1 Australia Paid work    211.
#> 2 Austria   Paid work    280.
#> 3 Belgium   Paid work    194.
#> 4 Canada    Paid work    269.
#> 5 Denmark   Paid work    200.
#> 6 Estonia   Paid work    231.
#> # … with 455 more rows
```


Distinct rows

```
time_use %>%
  distinct(category)
```

```
#> # A tibble: 14 x 1
#>    category
#>    <chr>
#>  1 Paid work
#>  2 Education
#>  3 Care for household members
#>  4 Housework
#>  5 Shopping
#>  6 Other unpaid work & volunteering
#>  7 Sleep
#>  8 Eating and drinking
#>  9 Personal care
#> 10 Sports
#> 11 Attending events
#> 12 Seeing friends
#> 13 TV and Radio
#> 14 Other leisure activities
```

```
time_use %>%
  distinct(country, category)
```

```
#> # A tibble: 461 x 2
#>   country   category
#>   <chr>     <chr>
#> 1 Australia Paid work
#> 2 Austria   Paid work
#> 3 Belgium   Paid work
#> 4 Canada    Paid work
#> 5 Denmark   Paid work
#> 6 Estonia   Paid work
#> # … with 455 more rows
```


Verbs

- rowwise

- `slice()`: subsets rows using their positions

```
time_use %>%
  slice((n() - 4):n())
```

```
#> # A tibble: 5 x 3
#>   country      category                minutes
#>   <chr>        <chr>                     <dbl>
#> 1 UK           Other leisure activities    98.4
#> 2 USA          Other leisure activities    73.5
#> 3 China        Other leisure activities    53.0
#> 4 India        Other leisure activities   109.
#> 5 South Africa Other leisure activities    81.8
```

`n()` is a context dependent function: the current group size

Verbs
- group by

› `group_by()`: group by one or more variables

```
time_use %>%
  group_by(country)
```

```
#> # A tibble: 461 x 3
#> # Groups:   country [33]
#>   country   category  minutes
#>   <chr>     <chr>       <dbl>
#> 1 Australia Paid work    211.
#> 2 Austria   Paid work    280.
#> 3 Belgium   Paid work    194.
#> 4 Canada    Paid work    269.
#> 5 Denmark   Paid work    200.
#> 6 Estonia   Paid work    231.
#> # … with 455 more rows
```


Verbs
- groupwise

› `group_by()`: use in conjunction with other verbs

```
time_use %>%
  group_by(country) %>%
  slice((n() - 4):n())
```

```
#> # A tibble: 165 x 3
#> # Groups:   country [33]
#>   country   category                  minutes
#>   <chr>     <chr>                       <dbl>
#> 1 Australia Sports                      19.0
#> 2 Australia Attending events             6.00
#> 3 Australia Seeing friends              40.0
#> 4 Australia TV and Radio               140.
#> 5 Australia Other leisure activities    76.1
#> 6 Austria   Sports                      32.1
#> # … with 159 more rows
```


Verbs
- groupwise

› `slice()` shortcuts: `slice_head()` & `slice_tail()`

```
time_use %>%
  group_by(country) %>%
  slice_tail(n = 5)
```

```
#> # A tibble: 165 x 3
#> # Groups:   country [33]
#>   country   category                  minutes
#>   <chr>     <chr>                       <dbl>
#> 1 Australia Sports                      19.0
#> 2 Australia Attending events             6.00
#> 3 Australia Seeing friends              40.0
#> 4 Australia TV and Radio               140.
#> 5 Australia Other leisure activities    76.1
#> 6 Austria   Sports                      32.1
#> # … with 159 more rows
```


Verbs
- group by
- ungroup

› `ungroup()`: removes grouping

```
time_use %>%
  group_by(country) %>%
  slice_tail(n = 5) %>%
  ungroup()
```

```
#> # A tibble: 165 x 3
#>   country   category                  minutes
#>   <chr>     <chr>                       <dbl>
#> 1 Australia Sports                      19.0
#> 2 Australia Attending events             6.00
#> 3 Australia Seeing friends              40.0
#> 4 Australia TV and Radio               140.
#> 5 Australia Other leisure activities    76.1
#> 6 Austria   Sports                      32.1
#> # … with 159 more rows
```

Verbs
- rowwise

› `slice_sample()` randomly selects rows

```
set.seed(220) # an arbitrary number
time_use %>%
  slice_sample(n = 10)
```

```
#> # A tibble: 10 x 3
#>    country     category                          minutes
#>    <chr>       <chr>                               <dbl>
#>  1 Norway      Housework                            82.9
#>  2 Austria     Education                            26.9
#>  3 Spain       Other leisure activities             84.7
#>  4 Estonia     Paid work                           231.
#>  5 Canada      Education                            36.0
#>  6 Turkey      Education                            29.0
#>  7 Netherlands Housework                           105.
#>  8 Australia   Sleep                               512.
#>  9 Australia   Other unpaid work & volunteering     57.5
#> 10 Germany     Housework                           109.
```


Verbs
- rowwise

› `arrange()`: arrange rows by columns

```
time_use %>%
  arrange(minutes)
```

```
#> # A tibble: 461 x 3
#>   country   category                    minutes
#>   <chr>     <chr>                         <dbl>
#> 1 Japan     Care for household members     0
#> 2 Lithuania Attending events               1.35
#> 3 China     Attending events               2.00
#> 4 Turkey    Attending events               2.58
#> 5 Poland    Attending events               2.81
#> 6 Korea     Attending events               4.45
#> # … with 455 more rows
```

`arrange()` in ascending order by default

Verbs
- rowwise

› `arrange()`: arrange rows by columns

```
time_use %>%
  arrange(desc(minutes)) # -minutes
```

```
#> # A tibble: 461 x 3
#>   country      category minutes
#>   <chr>        <chr>      <dbl>
#> 1 South Africa Sleep       553.
#> 2 China        Sleep       542.
#> 3 Estonia      Sleep       530.
#> 4 India        Sleep       528.
#> 5 USA          Sleep       528.
#> 6 New Zealand  Sleep       526
#> # … with 455 more rows
```

use `desc()` in descending order

Verbs
- rowwise

› `arrange()`: arrange rows by columns

```
time_use %>%
  arrange(country, desc(minutes))
```

```
#> # A tibble: 461 x 3
#>   country   category                  minutes
#>   <chr>     <chr>                       <dbl>
#> 1 Australia Sleep                       512.
#> 2 Australia Paid work                   211.
#> 3 Australia TV and Radio                140.
#> 4 Australia Housework                   132.
#> 5 Australia Eating and drinking          89.1
#> 6 Australia Other leisure activities     76.1
#> # … with 455 more rows
```

Verbs
- rowwise

› `filter()`: subsets rows using columns

```
time_use %>%
  filter(minutes == max(minutes))
```

```
#> # A tibble: 1 x 3
#>   country      category minutes
#>   <chr>        <chr>      <dbl>
#> 1 South Africa Sleep       553.
```

`filter()` observations that satisfy your conditions

Verbs
- rowwise

› `filter()`: subsets rows using columns

```
time_use %>%
  group_by(country) %>%
  filter(minutes == max(minutes))
```

```
#> # A tibble: 33 x 3
#> # Groups:   country [33]
#>   country   category minutes
#>   <chr>     <chr>      <dbl>
#> 1 Australia Sleep       512.
#> 2 Austria   Sleep       498.
#> 3 Belgium   Sleep       513.
#> 4 Canada    Sleep       520
#> 5 Denmark   Sleep       489.
#> 6 Estonia   Sleep       530.
#> # … with 27 more rows
```


Verbs
- rowwise

› `filter()`: subsets rows using columns

```
anz <- c("Australia", "New Zealand")
time_use %>%
  filter(country %in% anz)
```

```
#> # A tibble: 28 x 3
#>   country     category                  minutes
#>   <chr>       <chr>                       <dbl>
#> 1 Australia   Paid work                   211.
#> 2 New Zealand Paid work                   241.
#> 3 Australia   Education                    27.0
#> 4 New Zealand Education                    29
#> 5 Australia   Care for household members    44.5
#> 6 New Zealand Care for household members    30
#> # … with 22 more rows
```


Verbs
- rowwise

› `filter()`: subsets rows using columns

```
time_use %>%
  filter(!(country %in% anz)) # ! logical negation (NOT)
```

```
#> # A tibble: 433 x 3
#>   country category  minutes
#>   <chr>   <chr>       <dbl>
#> 1 Austria Paid work    280.
#> 2 Belgium Paid work    194.
#> 3 Canada  Paid work    269.
#> 4 Denmark Paid work    200.
#> 5 Estonia Paid work    231.
#> 6 Finland Paid work    200.
#> # … with 427 more rows
```

Verbs
- rowwise

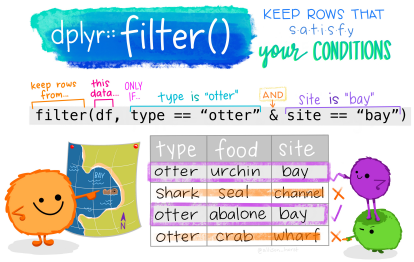
› `filter()`: subsets rows using columns

```
time_use %>%
  filter(country %in% anz, minutes > 30)
## time_use %>%
##   filter(country %in% anz & minutes > 30)
```

```
#> # A tibble: 19 x 3
#>    country     category                          minutes
#>    <chr>       <chr>                               <dbl>
#>  1 Australia   Paid work                           211.
#>  2 New Zealand Paid work                           241.
#>  3 Australia   Care for household members           44.5
#>  4 Australia   Housework                           132.
#>  5 New Zealand Housework                           110.
#>  6 Australia   Other unpaid work & volunteering     57.5
#>  7 New Zealand Other unpaid work & volunteering     59
#>  8 Australia   Sleep                               512.
#>  9 New Zealand Sleep                               526
#> 10 Australia   Eating and drinking                  89.1
#> 11 New Zealand Eating and drinking                  80
#> 12 Australia   Personal care                        56.0
```


Verbs
- rowwise

› `filter()`: subsets rows using columns



Verbs
- rowwise

› `filter()`: subsets rows using columns

```
time_use %>%
  filter(country %in% anz | minutes > 30)
```

```
#> # A tibble: 337 x 3
#>   country   category  minutes
#>   <chr>     <chr>       <dbl>
#> 1 Australia Paid work    211.
#> 2 Austria   Paid work    280.
#> 3 Belgium   Paid work    194.
#> 4 Canada    Paid work    269.
#> 5 Denmark   Paid work    200.
#> 6 Estonia   Paid work    231.
#> # … with 331 more rows
```

|: either ... or ...

Logical operators

```
x <- c(TRUE, FALSE, TRUE, FALSE)
y <- c(FALSE, TRUE, TRUE, FALSE)
```

› element-wise comparisons:

```
x & y
```

```
#> [1] FALSE FALSE  TRUE FALSE
```

```
x | y
```

```
#> [1]  TRUE  TRUE  TRUE FALSE
```

› first-element only comparisons:

```
x && y
```

```
#> [1] FALSE
```

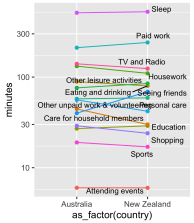
```
x || y
```

```
#> [1] TRUE
```

Verbs
- rowwise

- `filter()`: subsets rows using columns

```
time_use_anz <- time_use %>%
  filter(country %in% anz)
```



Verbs
- rowwise
- colwise

- `select()`: subsets columns using their names and types

```
time_use_anz %>%
  select(country, category)
## time_use_anz %>%
##   select(-minutes) # !minutes
## time_use_anz %>%
##   select(country:category)
```

```
#> # A tibble: 28 x 2
#>   country     category
#>   <chr>       <chr>
#> 1 Australia   Paid work
#> 2 New Zealand Paid work
#> 3 Australia   Education
#> 4 New Zealand Education
#> 5 Australia   Care for household members
#> 6 New Zealand Care for household members
#> # … with 22 more rows
```


Verbs
- rowwise
- colwise

Selection helpers

- `starts_with()`: starts with a prefix.
- `ends_with()`: ends with a suffix.
- `contains()`: contains a literal string.
- more helpers

```
time_use_anz %>%
  select(starts_with("c"))
```

```
#> # A tibble: 28 x 2
#>   country     category
#>   <chr>       <chr>
#> 1 Australia   Paid work
#> 2 New Zealand Paid work
#> 3 Australia   Education
#> 4 New Zealand Education
#> 5 Australia   Care for household members
#> 6 New Zealand Care for household members
```


Verbs
- rowwise
- colwise

- `mutate()`: creates, modifies, and deletes columns

```
time_use_anz2 <- time_use_anz %>%
  mutate(
    # new_column = f(existing_column)
    hours = minutes / 60,
    iso = case_when(
      country == "Australia" ~ "AU",
      TRUE ~ "NZ"))
time_use_anz2
```

```
#> # A tibble: 28 x 5
#>   country     category                  minutes hours iso
#>   <chr>       <chr>                       <dbl> <dbl> <chr>
#> 1 Australia   Paid work                     211.  3.52  AU
#> 2 New Zealand Paid work                     241.  4.02  NZ
#> 3 Australia   Education                      27.0 0.450 AU
#> 4 New Zealand Education                      29   0.483 NZ
#> 5 Australia   Care for household members     44.5 0.742 AU
#> 6 New Zealand Care for household members     30   0.5   NZ
#> # … with 22 more rows
```

Verbs
- rowwise
- **colwise**

› `mutate()`: creates, modifies, and deletes columns

`case_when()`: when it's the case, do something


```
z <- 1:10
case_when(
  # LHS ~ RHS
  # logical cond ~ replacement val
  z < 5 ~ "less than 5",
  z > 5 ~ "greater than 5",
  TRUE ~ "equal to 5"
)
```

```
#>  [1] "less than 5"    "less than 5"
#>  [3] "less than 5"    "less than 5"
#>  [5] "equal to 5"     "greater than 5"
#>  [7] "greater than 5" "greater than 5"
#>  [9] "greater than 5" "greater than 5"
```


Verbs
- rowwise
- **colwise**

› `summarise()`: summarises to one row

```
time_use_anz2 %>%
  summarise( # summarize()
    min = min(hours),
    max = max(hours),
    avg = mean(hours))
```

```
#> # A tibble: 1 x 3
#>     min   max   avg
#>   <dbl> <dbl> <dbl>
#> 1   0.1  8.77  1.72
```


Verbs
- rowwise
- **colwise**

› `summarise()`: summarises each group to fewer rows

```
time_use_anz2 %>%
  group_by(category) %>%
  summarise(
    min = min(hours),
    max = max(hours),
    avg = mean(hours))
```

```
#> # A tibble: 14 x 4
#>    category                            min   max   avg
#>    <chr>                             <dbl> <dbl> <dbl>
#>  1 Attending events                  0.1   0.100 0.100
#>  2 Care for household members        0.5   0.742 0.621
#>  3 Eating and drinking               1.33  1.48  1.41
#>  4 Education                         0.450 0.483 0.467
#>  5 Housework                         1.83  2.20  2.02
#>  6 Other leisure activities          1.27  1.42  1.34
#>  7 Other unpaid work & volunteering 0.959 0.983 0.971
#>  8 Paid work                         3.52  4.02  3.77
#>  9 Personal care                     0.7   0.934 0.817
#> 10 Seeing friends                    0.667 1.15  0.908
```

Chain with %>%

```
time_use_anz <- time_use %>%
  filter(country %in% anz)
```

```
time_use_anz2 <- time_use_anz %>%
  mutate(
    # new_column = f(existing_column)
    hours = minutes / 60,
    iso = case_when(
      country == "Australia" ~ "AU",
      TRUE ~ "NZ"))
```

```
time_use_anz2 %>%
  group_by(category) %>%
  summarise(
    min = min(hours),
    max = max(hours),
    avg = mean(hours))
```

```
time_use %>%
  filter(country %in% anz) %>%
  mutate(hours = minutes / 60) %>%
  group_by(category) %>%
  summarise(
    min = min(hours),
    max = max(hours),
    avg = mean(hours))
```


When to %>%

```
time_use %>%
  filter(country %in% anz) %>%
  mutate(hours = minutes / 60) %>%
  group_by(category) %>%
  summarise(
    min = min(hours),
    max = max(hours),
    avg = mean(hours))
```

1. Linear code dependency structure
2. < 10 steps
3. Inputs and outputs of the same type
   - {dplyr} verbs, tibble in and out

Handy shortcuts

```
time_use_anz %>%
  group_by(country) %>%
  summarise(n = n())
## time_use_anz %>%
##   count(country)
## time_use_anz %>%
##   group_by(Country) %>%
##   tally()
```

```
#> # A tibble: 2 x 2
#>   country         n
#>   <chr>       <int>
#> 1 Australia      14
#> 2 New Zealand    14
```


Hello again, SQL!

```
library(RSQLite)
con <- dbConnect(SQLite(), dbname = "data/pisa/pisa-student.db")
pisa_db <- tbl(con, "pisa")
pisa_db
```

```
#> # Source:   table<pisa> [?? x 22]
#> # Database: sqlite 3.34.1
#> #   [/Users/wany568/Teaching/stats220/lectures/data/pisa/pisa-student.db]
#>    year country school_id student_id mother_educ father_educ
#>   <dbl> <chr>   <chr>     <chr>      <chr>       <chr>
#> 1  2000 ALB     1001      1          <NA>        <NA>
#> 2  2000 ALB     1001      3          <NA>        <NA>
#> 3  2000 ALB     1001      6          <NA>        <NA>
#> 4  2000 ALB     1001      8          <NA>        <NA>
#> 5  2000 ALB     1001      11         <NA>        <NA>
#> 6  2000 ALB     1001      12         <NA>        <NA>
#> # … with more rows, and 16 more variables: gender <chr>,
#> #   computer <chr>, internet <chr>, math <dbl>, read <dbl>,
#> #   science <dbl>, stu_wgt <dbl>, desk <chr>, room <chr>,
#> #   dishwasher <chr>, television <chr>, computer_n <chr>,
#> #   car <chr>, book <chr>, wealth <dbl>, escs <dbl>
```

Write {dplyr} code as usual to manipulate database

```
pisa_sql <- pisa_db %>%
  filter(country %in% c("NZL", "AUS")) %>%
  group_by(country) %>%
  summarise(avg_math = mean(math, na.rm = TRUE)) %>%
  arrange(desc(math))
pisa_sql
```

```
#> # Source:     lazy query [?? x 2]
#> # Database:   sqlite 3.34.1
#> #   [/Users/wany568/Teaching/stats220/lectures/data/pisa/pisa-student.db]
#> # Ordered by: desc(math)
#>   country avg_math
#>   <chr>      <dbl>
#> 1 NZL         511.
#> 2 AUS         502.
```


Speak in SQL from R

Show SQL queries

```
pisa_sql %>% show_query()
```

```
#> <SQL>
#> SELECT `country`, AVG(`math`) AS `avg_math`
#> FROM `pisa`
#> WHERE (`country` IN ('NZL', 'AUS'))
#> GROUP BY `country`
#> ORDER BY `math` DESC
```

Retrieve results to R

```
pisa_sql %>% collect()
```

```
#> # A tibble: 2 x 2
#>   country avg_math
#>   <chr>      <dbl>
#> 1 NZL         511.
#> 2 AUS         502.
```


Relational data

Multiple tables of data are called *relational data* because of the relations.

Keys

A key is a variable (or set of variables) that uniquely identifies an observation.

- A **primary key** uniquely identifies an observation in its own table.
- A **foreign key** uniquely identifies an observation in another table.

```
time_use
```

```
#> # A tibble: 461 x 3
#>   country   category  minutes
#>   <chr>     <chr>       <dbl>
#> 1 Australia Paid work    211.
#> 2 Austria   Paid work    280.
#> 3 Belgium   Paid work    194.
#> 4 Canada    Paid work    269.
#> 5 Denmark   Paid work    200.
#> 6 Estonia   Paid work    231.
#> # … with 455 more rows
```

```
(country_code <- read_csv("data/countrycode.csv"))
```

```
#> # A tibble: 100 x 2
#>   country country_name
#>   <chr>   <chr>
#> 1 AZE     Azerbaijan
#> 2 ARG     Argentina
#> 3 AUS     Australia
#> 4 AUT     Austria
#> 5 BEL     Belgium
#> 6 BRA     Brazil
#> # … with 94 more rows
```

00:30

Your turn

> “
>
> *What's the key for the `time_use` data?*

Two table verbs🤝

A second data table

- Join `country` from `country_code` to `time_use`, by common values
- Common values: `country` from `time_use`, but `country_name` from `country_code`

```
time_use %>%
  filter(country %in% c("New Zealand", "USA")) %>%
  distinct(country, .keep_all = TRUE)
```

```
#> # A tibble: 2 x 3
#>   country     category  minutes
#>   <chr>       <chr>       <dbl>
#> 1 New Zealand Paid work    241.
#> 2 USA         Paid work    251.
```

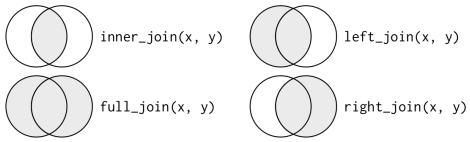
```
country_code %>%
  filter(country_name %in%
    c("New Zealand", "United States"))
```

```
#> # A tibble: 2 x 2
#>   country country_name
#>   <chr>   <chr>
#> 1 NZL     New Zealand
#> 2 USA     United States
```


Joins

- mutating joins

Mutating joins: add new variables to one data frame from matching observations in another.



Joins
- mutating joins

› `inner_join()`: All rows from `x` where there are matching values in `y`, and all columns from `x` and `y`

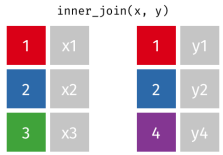


image credit: Garrick Aden-Buie

Joins
- mutating joins

› `inner_join()`: All rows from `x` where there are matching values in `y`, and all columns from `x` and `y`

```
time_use %>%
  inner_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 377 x 4
#>   country   category  minutes country.y
#>   <chr>     <chr>       <dbl> <chr>
#> 1 Australia Paid work    211. AUS
#> 2 Austria   Paid work    280. AUT
#> 3 Belgium   Paid work    194. BEL
#> 4 Canada    Paid work    269. CAN
#> 5 Denmark   Paid work    200. DNK
#> 6 Estonia   Paid work    231. EST
#> # … with 371 more rows
```


Joins
- mutating joins

› `left_join()`: All rows from `x`, and all columns from `x` and `y`. Rows in `x` with no match in `y` will have `NA` values in the new columns.

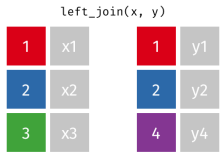


image credit: Garrick Aden-Buie

Joins
- mutating joins

› `left_join()`: All rows from `x`, and all columns from `x` and `y`. Rows in `x` with no match in `y` will have `NA` values in the new columns.

```
time_use %>%
  left_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 461 x 4
#>   country   category  minutes country.y
#>   <chr>     <chr>       <dbl> <chr>
#> 1 Australia Paid work    211. AUS
#> 2 Austria   Paid work    280. AUT
#> 3 Belgium   Paid work    194. BEL
#> 4 Canada    Paid work    269. CAN
#> 5 Denmark   Paid work    200. DNK
#> 6 Estonia   Paid work    231. EST
#> # … with 455 more rows
```

Joins
- mutating joins

› `left_join()`: All rows from `x`, and all columns from `x` and `y`. Rows in `x` with no match in `y` will have `NA` values in the new columns.

```
time_use %>%
  left_join(country_code, by = c("country" = "country_name"))%>%
  filter(country %in% c("New Zealand", "USA")) %>%
  group_by(country) %>%
  slice_head()
```

```
#> # A tibble: 2 x 4
#> # Groups:   country [2]
#>   country     category  minutes country.y
#>   <chr>       <chr>       <dbl> <chr>
#> 1 New Zealand Paid work    241. NZL
#> 2 USA         Paid work    251. <NA>
```


Joins
- mutating joins

› `right_join()`: All rows from `y`, and all columns from `x` and `y`. Rows in `y` with no match in `x` will have `NA` values in the new columns.

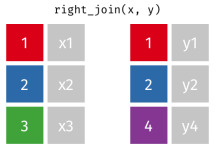


image credit: Garrick Aden-Buie

Joins
- mutating joins

› `right_join()`: All rows from `y`, and all columns from `x` and `y`. Rows in `y` with no match in `x` will have `NA` values in the new columns.

```
time_use %>%
  right_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 450 x 4
#>   country    category  minutes country.y
#>   <chr>      <chr>       <dbl> <chr>
#> 1 Australia Paid work    211. AUS
#> 2 Austria   Paid work    280. AUT
#> 3 Belgium   Paid work    194. BEL
#> 4 Canada    Paid work    269. CAN
#> 5 Denmark   Paid work    200. DNK
#> 6 Estonia   Paid work    231. EST
#> # … with 444 more rows
```


Joins
- mutating joins

› `full_join()`: All rows and all columns from both `x` and `y`. Where there are not matching values, returns `NA` for the one missing.

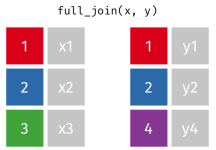


image credit: Garrick Aden-Buie

Joins
- mutating joins

› `full_join()`: All rows and all columns from both `x` and `y`. Where there are not matching values, returns `NA` for the one missing.

```
time_use %>%
  full_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 534 x 4
#>   country   category  minutes country.y
#>   <chr>     <chr>       <dbl> <chr>
#> 1 Australia Paid work    211. AUS
#> 2 Austria   Paid work    280. AUT
#> 3 Belgium   Paid work    194. BEL
#> 4 Canada    Paid work    269. CAN
#> 5 Denmark   Paid work    200. DNK
#> 6 Estonia   Paid work    231. EST
#> # … with 528 more rows
```


Joins
- mutating joins
- filtering joins

Filtering joins: filter observations from one data frame based on whether or not they match an observation in the other table.

› `semi_join()`: All rows from `x` where there are matching values in `y`, keeping just columns from `x`.

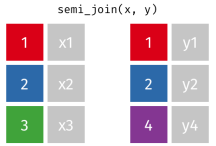


image credit: Garrick Aden-Buie

Joins
- mutating joins
- filtering joins

› `semi_join()`: All rows from `x` where there are matching values in `y`, keeping just columns from `x`.

```
time_use %>%
  semi_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 377 x 3
#>   country   category  minutes
#>   <chr>     <chr>       <dbl>
#> 1 Australia Paid work    211.
#> 2 Austria   Paid work    280.
#> 3 Belgium   Paid work    194.
#> 4 Canada    Paid work    269.
#> 5 Denmark   Paid work    200.
#> 6 Estonia   Paid work    231.
#> # … with 371 more rows
```


Joins
- mutating joins
- filtering joins

› `anti_join()`: All rows from `x` where there are **not** matching values in `y`, keeping just columns from `x`.

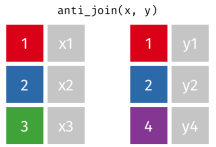


image credit: Garrick Aden-Buie

Joins

- mutating joins
- **filtering joins**

- `anti_join()`: All rows from `x` where there are **not** matching values in `y`, keeping just columns from `x`.

```
time_use %>%
  anti_join(country_code, by = c("country" = "country_name"))
```

```
#> # A tibble: 84 x 3
#>   country      category  minutes
#>   <chr>        <chr>       <dbl>
#> 1 Korea        Paid work    288.
#> 2 UK           Paid work    235.
#> 3 USA          Paid work    251.
#> 4 China        Paid work    315.
#> 5 India        Paid work    272.
#> 6 South Africa Paid work    189.
#> # … with 78 more rows
```


Useful functions

- one table verbs
  - `pull()`
  - `transmute()`
  - `relocate()`
- two table verbs
  - `bind_rows()`
  - `bind_cols()`
- set operations
  - `union()`
  - `union_all()`
  - `setdiff()`
  - `intersect()`

Upcoming R-Ladies meetup

Thursday, 8 April 2021

Creating Tables for R Markdown with kableExtra

Hosted by
Kim Fitter and 2 others

Share

What we'll do

Join us for an in-person meetup to learn about creating tables for reports in R Markdown, hosted by Izzy Johnson!

All levels of R users (including beginners!) are welcome.

Time: 6:00 arrival for a 6:30pm start and 7:45pm finish.

What to bring: Yourself! Optionally you can bring a laptop with R installed if you'd like to code along with the presentation.

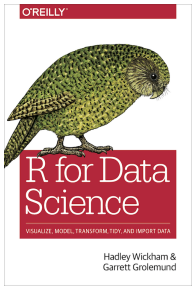
Plots are great, but sometimes tables can be a useful way to display data as well. Izzy will talk briefly about a few ways to create tables to display data in R, and then walk though how the kableExtra package can help customise your

R-Ladies Auckland
Public group

Thursday, 8 April 2021
6:00 pm to 7:45 pm NZST
Add to calendar

Xero
96 Saint Georges Bay Road · Auckland
How to find us

Reading



- Pipes
- Data transformation
- Relational data
- {dplyr} cheatsheet