Grammar of Data Wrangling

DATA 202 21FA, based on datasciencebox.org

Q&A

> Will we be working with different data?

We'll use a mix of old and new examples each week.

> When should we spend effort making graphs look good?

Homework, exams: always. Otherwise not necessary but always good practice.

> How do we remember which types of plots to make and how?

Class slides, RStudio cheatsheets, textbook, ...

Office hours

- Mondays at 2:30pm Maroon lab
- Appointments for other times encouraged!

So far

- *R/RStudio/Rmarkdown/Git*: a toolkit for reproducible collaborative analysis and reporting
- `ggplot2`: a *Grammar of Graphics*
  - a language for describing and building visualizations
  - concepts apply to many other toolkits

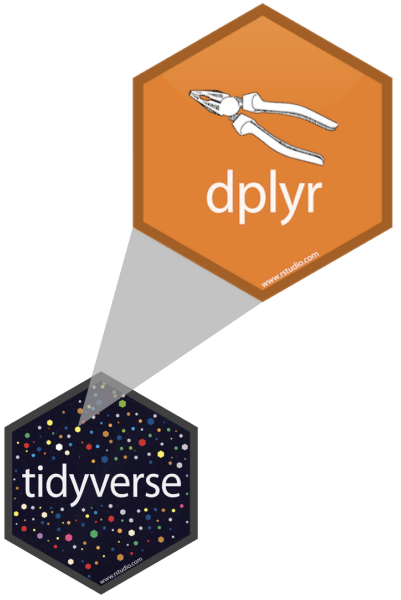
This week:

- `dplyr`: a *Grammar of Data Transformation*
  - basic concepts apply in SQL and other environments (e.g., Python Pandas)

Grammar of data wrangling

A grammar of data wrangling...

... based on the concepts of functions as verbs that manipulate data frames



- `select`: pick columns by name
- `arrange`: reorder rows
- `slice_head`: pick first rows (`_tail`: last rows)
- `slice_sample`: pick rows randomly
- `filter`: pick rows matching criteria
- `distinct`: filter for unique rows
- `mutate`: add new variables
- `summarize`: reduce variables to values
- `pull`: grab a column as a vector
- ... (many more)

Rules of dplyr functions

- First argument is *always* a data frame
- Subsequent arguments say what to do with that data frame
- Always return a data frame
- Don't modify in place

Don't worry, R shares memory, so copies don't waste space.

Data: Hotel bookings

- Data from two hotels: one resort and one city hotel
- Observations: Each row represents a hotel booking
- Goal for original data collection: Development of prediction models to classify a hotel booking's likelihood to be cancelled (Antonia et al., 2019)

```
library(tidyverse)
hotels <- read_csv("data/hotels.csv")
```

Source: TidyTuesday

First look: Variables

```
names(hotels)
```

```
##  [1] "hotel"
##  [2] "is_canceled"
##  [3] "lead_time"
##  [4] "arrival_date_year"
##  [5] "arrival_date_month"
##  [6] "arrival_date_week_number"
##  [7] "arrival_date_day_of_month"
##  [8] "stays_in_weekend_nights"
##  [9] "stays_in_week_nights"
## [10] "adults"
## [11] "children"
## [12] "babies"
## [13] "meal"
## [14] "country"
## [15] "market_segment"
## [16] "distribution_channel"
## [17] "is_repeated_guest"
## [18] "previous_cancellations"
...
```

Second look: Overview

```
glimpse(hotels)
```

```
## Rows: 119,390
## Columns: 32
## $ hotel                          <chr> "Resort Hotel", "Resort …
## $ is_canceled                    <dbl> 0, 0, 0, 0, 0, 0, 0, 0, …
## $ lead_time                      <dbl> 342, 737, 7, 13, 14, 14,…
## $ arrival_date_year              <dbl> 2015, 2015, 2015, 2015, …
## $ arrival_date_month             <chr> "July", "July", "July", …
## $ arrival_date_week_number       <dbl> 27, 27, 27, 27, 27, 27, …
## $ arrival_date_day_of_month      <dbl> 1, 1, 1, 1, 1, 1, 1, 1, …
## $ stays_in_weekend_nights        <dbl> 0, 0, 0, 0, 0, 0, 0, 0, …
## $ stays_in_week_nights           <dbl> 0, 0, 1, 1, 2, 2, 2, 2, …
## $ adults                         <dbl> 2, 2, 1, 1, 2, 2, 2, 2, …
## $ children                       <dbl> 0, 0, 0, 0, 0, 0, 0, 0, …
## $ babies                         <dbl> 0, 0, 0, 0, 0, 0, 0, 0, …
## $ meal                           <chr> "BB", "BB", "BB", "BB", …
## $ country                        <chr> "PRT", "PRT", "GBR", "GB…
## $ market_segment                 <chr> "Direct", "Direct", "Dir…
## $ distribution_channel           <chr> "Direct", "Direct", "Dir…
...
```

Select a single column

View only `lead_time` (number of days between booking and arrival date):

```
select(hotels, lead_time)
```

```
## # A tibble: 119,390 × 1
##   lead_time
##       <dbl>
## 1       342
## 2       737
## 3         7
## 4        13
## 5        14
## 6        14
## # … with 119,384 more rows
```

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## # … with 119,384 more rows
```

- Start with the function (a verb): `select()`
- First argument: data frame we're working with, `hotels`
- Second argument: variable we want to select, `lead_time`
- Result: data frame with 119390 rows and 1 column

> dplyr functions always expect a data frame and always yield a data frame.

```
select(hotels, lead_time)
```

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## # A tibble: 119,390 × 1
##   lead_time
##       <dbl>
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View only the `hotel` type and `lead_time`:

```
select(hotels, hotel, lead_tim
```

```
## # A tibble: 119,390 × 2
##   hotel        lead_time
##   <chr>            <dbl>
## 1 Resort Hotel       342
## 2 Resort Hotel       737
## 3 Resort Hotel         7
## 4 Resort Hotel        13
## 5 Resort Hotel        14
## 6 Resort Hotel        14
## # … with 119,384 more rows
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## # … with 119,384 more rows
```

What if we wanted to select these columns, and then arrange the data in descending order of lead time?

Data wrangling, step-by-step

Select:

```
hotels %>%
  select(hotel, lead_time)
```

```
## # A tibble: 119,390 × 2
##   hotel        lead_time
##   <chr>            <dbl>
## 1 Resort Hotel       342
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## 5 Resort Hotel        14
## 6 Resort Hotel        14
## # … with 119,384 more rows
```

Select, then arrange:

```
hotels %>%
  select(hotel, lead_time) %>%
  arrange(desc(lead_time))
```

```
## # A tibble: 119,390 × 2
##   hotel        lead_time
##   <chr>            <dbl>
## 1 Resort Hotel       737
## 2 Resort Hotel       709
## 3 City Hotel         629
## 4 City Hotel         629
## 5 City Hotel         629
## 6 City Hotel         629
## # … with 119,384 more rows
```

Pipes

What is a pipe?

In programming, a pipe is a technique for passing information from one process to another.

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What is a pipe?

In programming, a pipe is a technique for passing information from one process to another.

- Start with the data frame `hotels`, and pass it to the `select()` function,
- then we select the variables `hotel` and `lead_time`,

```
hotels %>%
  select(hotel, lead_time) %>%
  arrange(desc(lead_time))
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## # A tibble: 119,390 × 2
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## # … with 119,384 more rows
```

What is a pipe?

In programming, a pipe is a technique for passing information from one process to another.

- Start with the data frame `hotels`, and pass it to the `select()` function,
- then we select the variables `hotel` and `lead_time`,
- and then we arrange the data frame by `lead_time` in descending order.

```
hotels %>%
  select(hotel, lead_time) %>%
  arrange(desc(lead_time))
```

```
## # A tibble: 119,390 × 2
##   hotel        lead_time
##   <chr>            <dbl>
## 1 Resort Hotel       737
## 2 Resort Hotel       709
## 3 City Hotel         629
## 4 City Hotel         629
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- You can think about the following sequence of actions - find keys, unlock car, start car, drive to work, park.

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- Expressed as a set of nested functions in R pseudocode this would look like:

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

How does a pipe work?

- You can think about the following sequence of actions - find keys, unlock car, start car, drive to work, park.
- Expressed as a set of nested functions in R pseudocode this would look like:

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

- Writing it out using pipes give it a more natural (and easier to read) structure:

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

A note on piping and layering

- %>% used mainly in **dplyr** pipelines, *we pipe the output of the previous line of code as the first input of the next line of code*

A note on piping and layering

- `%>%` used mainly in **dplyr** pipelines, *we pipe the output of the previous line of code as the first input of the next line of code*
- `+` used in **ggplot2** plots is used for "layering", *we create the plot in layers, separated by* `+`

dplyr

❌

```
hotels +
  select(hotel, lead_time)
```

```
## Error in select(hotel, lead_time): object 'hotel' not found
```

✅

```
hotels %>%
  select(hotel, lead_time)
```

```
## # A tibble: 119,390 × 2
##   hotel        lead_time
##   <chr>            <dbl>
## 1 Resort Hotel       342
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...
```

ggplot2

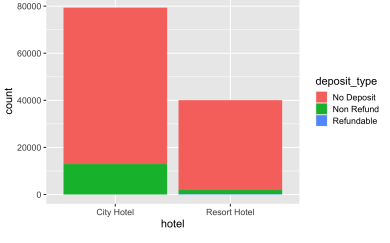
❌

```
ggplot(hotels, aes(x = hotel, fill = deposit_type)) %>%
  geom_bar()
```

```
## Error: `mapping` must be created by `aes()`
## Did you use %>% instead of +?
```

✅

```
ggplot(hotels, aes(x = hotel, fill = deposit_type)) +
  geom_bar()
```



Code Style

Many of the styling principles are consistent across `%>%` and `+`:

- always a space before
- always a line break after (for pipelines with more than 2 lines)

❌

```
ggplot(hotels,aes(x=hotel,y=deposit_type))+geom_bar()
```

✅

```
ggplot(hotels, aes(x = hotel, y = deposit_type)) +
  geom_bar()
```

Code Style

> "Good coding style is like correct punctuation: you can manage without it, butitsuremakesthingseasiertoread."
>
> Hadley Wickham

- Recommended: Tidyverse style guide https://style.tidyverse.org/

Summary

- File names and code chunks: `data-wrangling`, not `Data Wrangling`.
- Variable names: `hourly_rides`, not `hourlyRides` or `hourly.rides` or `rides_by_hour_with_weather`
  - Informative but short. Don't reuse.

Spacing

- Put a space before and after all infix operators (=, +, -, <-, etc.), and when naming arguments in function calls
- Always put a space after a comma, and never before (just like in regular English)

```
# Good
average <- mean(feet * 12 + inches, na.rm = TRUE)

# Bad
average<-mean(feet*12+inches,na.rm=TRUE)
```