

Data wrangling

Raw to tidy data

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Learning objectives

Today we will...

- clean our first dataset
- implement literate programming principles
- use `dplyr` verbs to wrangle columns and rows
- save our tidy dataset

Review: Workflow

- let's first make sure we've got our project properly set-up

Workflow bare minimum

- self-contained project
 - everything available in one folder
 - e.g., RProjects
- README file
 - a markdown (.md) file
 - describing the folder/analysis structure
 - can be updated as you build the project

RProjects

- a folder containing
 - an `.RProj` file (which opens RStudio)
 - all folders/files required for a project
- `File > New Project > New Directory > New Project > New Project > Create Project`

README

- to create an `.md` file: `File > New File > Markdown File`
- create informative heading
 - describe project purpose
 - describe folders/scripts as they currently are
- save/Preview as `README.md` in the project folder

here

- `here` package
 - will always access the project folder
 - try running `here()` from within a project; what's the output?

Project folder structure

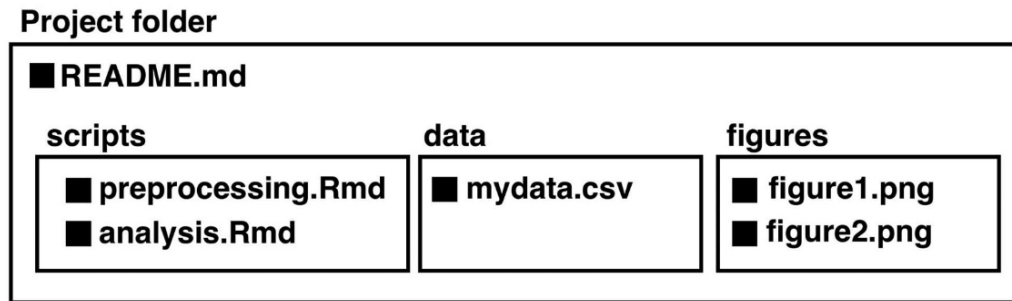


Figure 2.4. Folder structure for a data analysis project; black squares represent data files

Figure 1: Image source: Winter (2019)

Review: Reproducible code

- is located within a project
 - which also contains all relevant data/files
- runs linearly (from top to bottom)
 - loads all required packages at the top
 - uses file paths relative to its project
 - is created/edited after running `Session > Restart R`
- at the very least, ends with a section (e.g., `# Session Info`) containing `sessionInfo()`
 - but other options: `renv` package, `targets` package, `docker` for environment containers

Checklist

RProject

- `.RProj`
- `README.md`
- `data/`
- `scripts/` (for analyses)
- `notes/` (if for class notes)

Scripts (.qmd/.Rmd)

- load libraries at beginning
- chunks run linearly (top-to-bottom)
- script has helpful headings
- contains text to describe stream of thought
- code has helpful comments
- `sessionInfo()` at the end

Data cleaning

- or data wrangling, tidying, etc.
 - each can have a different specific meaning
 - but all refer to steps taken to tame raw/wild data

‘wrangle’ defined

/ ˈræŋ ɪ /

noun

a dispute or argument, typically one that is long and complicated. “an insurance wrangle is holding up compensation payments”

verb

1. have a long, complicated dispute or argument. “the bureaucrats continue wrangling over the fine print”
2. NORTH AMERICAN round up, herd, or take charge of (livestock). “the horses were wrangled early”

Data Wrangling

- data wrangling = tidying + transforming
- an often long, arduous stage of analysis

Tidy

- re-shaping
 - e.g., from wide to long data

- outcome:
 - each column = a variable
 - each row = an observation

Transform

- filtering
- creating new variables based on observations (e.g., reaction times)
- computing summary statistics (e.g., means)

Why tidy data?

- helps future you
 - and collaborators
- facilitates sharing your data *and* code (Laurinavichyute et al., 2022)
- in short: facilitates reproducibility!

What does tidy data look like?

Three rules (Wickham et al., 2023):

1. Each variable is a column, each column is a variable
2. Each observation is a row, each row is an observation
3. Each value is a cell, each cell is a single value

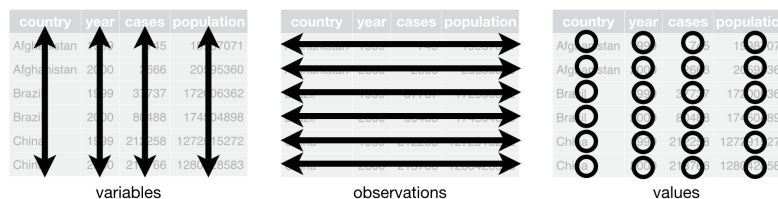


Figure 2: [Image source](#): Wickham et al. (2023) (all rights reserved)

- N.B., how you define a *variable* or *observation* is relative to what you want to do
 - for now, let's consider a single trial per participant as an observation

the tidyverse

- a collection of R packages for tidy data
- you need to load a package at the beginning of every session
 - today we will mostly use functions from the `dplyr` package
 - * if you load the `tidyverse` you don't need to also load `dplyr`

```
# load tidyverse
library(tidyverse)
```

💡 package versions

- you can check the package version with:

```
packageVersion("tidyverse")
```

```
[1] '2.0.0'
```

- need to update?

```
# update a single package
install.packages("tidyverse")
```

- what about your other packages?

```
# which packages need updating?
old.packages()
# update all old packages
update.packages()
```

base R pipe |>

- takes the object before it and feeds it into the next command
 - the pipe could be read as “and then”
 - there's a useful shortcut: **Ctrl/Cmd+Shift+M**
 - N.B., pre-2023 the only pipe was `%>%` (`magrittr` package)

```

1 # take data frame and then...
2 iris |>
3   # print the head
4   head()

```

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
4	4.6	3.1	1.5	0.2	setosa
5	5.0	3.6	1.4	0.2	setosa
6	5.4	3.9	1.7	0.4	setosa



Figure 3: Image source: [magittr documentation](#) (all rights reserved)

load our data

```

# load lifetime data
readr::read_csv(here::here("data/data_lifetime_pilot.csv"))

```

```

# A tibble: 4,431 x 28
  RECORDING_SESSION_LABEL TRIAL_INDEX EYE_USED IA_DWELL_TIME
  <chr>                   <dbl> <chr>         <dbl>
1 px3                     1 RIGHT         0
2 px3                     2 RIGHT         0
3 px3                     3 RIGHT         0
4 px3                     3 RIGHT         0

```



```

5 px3                3 RIGHT                0
6 px3                3 RIGHT                0
7 px3                3 RIGHT                0
8 px3                3 RIGHT                0
9 px3                4 RIGHT                0
10 px3               5 RIGHT                0
# i 4,421 more rows
# i 24 more variables: IA_FIRST_FIXATION_DURATION <dbl>,
#   IA_FIRST_RUN_DWELL_TIME <dbl>, IA_FIXATION_COUNT <dbl>, IA_ID <dbl>,
#   IA_LABEL <chr>, IA_REGRESSION_IN <dbl>, IA_REGRESSION_IN_COUNT <dbl>,
#   IA_REGRESSION_OUT <dbl>, IA_REGRESSION_OUT_COUNT <dbl>,
#   IA_REGRESSION_PATH_DURATION <dbl>, KeyPress <dbl>, rt <dbl>, bio <chr>,
#   critical <chr>, gender <chr>, item_id <dbl>, list <dbl>, match <chr>, ...

```

- was anything added to the Environment pane (top right box in RStudio)?

variable assignment with <-

- `object_name <- code_output_to_be_saved_as_object_name`

```

1 # load lifetime data and store it under df_lifetime
2 df_lifetime <- readr::read_csv(here::here("data/data_lifetime_pilot.csv"),
3                               # for special characters
4                               locale = readr::locale(encoding = "latin1")
5                               )

```

- you should now see the object `df_lifetime` in the Environment pane

A note on annotation

- annotate as you go: provide useful comments to describe your code (`# comment`)
- you always have at least one collaborator: future you!
 - comments

First we load required libraries.

```

1 # load libraries
2 library(tidyverse) # for e.g., wrangling and plotting
3 library(here) # for file-paths relative to project folder

```

Tidyverse verbs

- verbs are functions from the **tidyverse** package
- for data tidying and transforming we'll mostly use verbs from the **dplyr** package, which is part of the **tidyverse**
- check out [RLadies Freiburg](#) to see a [YouTube video](#) that covers most of these verbs

Wrangling columns

`rename()`

- one of the first things you'll often want to do is rename some variables
- let's start by re-naming some of our variables
 - e.g., `RECORDING_SESSION_LABEL` is a long way of saying 'participant'

```
1 # rename variables
2 df_lifetime <- df_lifetime |> # make df_lifetime from df_lifetime BUT THEN
3   rename("px" = RECORDING_SESSION_LABEL, # rename a variable and (comma = 'and')
4         "trial" = TRIAL_INDEX) # another variable
```

Exercise

Change the following names:

- `EYE_USED` to `eye`
- `IA_DWELL_TIME` to `tt`
- `IA_FIRST_FIXATION_DURATION` to `ff`
- `IA_FIXATION_COUNT` to `fix_count`
- `IA_FIRST_RUN_DWELL_TIME` to `fp`
- `IA_ID` to `region_n`
- `IA_LABEL` to `region_text`

- `IA_REGRESSION_IN` to `reg_in`
- `IA_REGRESSION_IN_COUNT` to `reg_in_count`
- `IA_REGRESSION_OUT` to `reg_out`
- `IA_REGRESSION_OUT_COUNT` to `reg_out_count`
- `IA_REGRESSION_PATH_DURATION` to `rpd`
- `name_vital_status` to `lifetime`

```
# the names should then look like this:
```

```
names(df_lifetime)
```

```
[1] "px"          "trial"       "eye"         "tt"
[5] "ff"          "fp"          "fix_count"   "region_n"
[9] "region_text" "reg_in"      "reg_in_count" "reg_out"
[13] "reg_out_count" "rpd"        "KeyPress"     "rt"
[17] "bio"         "critical"    "gender"       "item_id"
[21] "list"        "match"       "condition"    "name"
[25] "lifetime"    "tense"       "type"         "yes_press"
```

relocate

- the second thing you might want to do is reorder your variables so the most important/relevant are near the beginning and ordered logically
 - let's order our continuous reading time variables from 'earliest' to 'latest' measure

```
df_lifetime <- df_lifetime |>
  relocate(ff,fp,rpd,tt, .after="eye") |>
  relocate(region_n, region_text, .after="trial")
```

```
names(df_lifetime[1:10])
```

```
[1] "px"          "trial"       "region_n"    "region_text" "eye"
[6] "ff"          "fp"          "rpd"         "tt"          "fix_count"
```

mutate()

Mutate column(s):

- new columns

```
1 df_lifetime <- df_lifetime |>
2   mutate(new_column = "new")
```

- what will `new_column` contain?

```
df_lifetime |>
  select(px, new_column, trial) |>
  head()
```

```
# A tibble: 6 x 3
  px    new_column trial
<chr> <chr>      <dbl>
1 px3    new          1
2 px3    new          2
3 px3    new          3
4 px3    new          3
5 px3    new          3
6 px3    new          3
```

- change existing column

```
1 df_lifetime <- df_lifetime |>
2   mutate(new_column = px,
3          trial = trial + 5)
```

- what will new_column and trial contain?

```
df_lifetime |>
  select(px, new_column, trial) |>
  head()
```

```
# A tibble: 6 x 3
  px    new_column trial
<chr> <chr>      <dbl>
1 px3    px3          6
2 px3    px3          7
3 px3    px3          8
4 px3    px3          8
5 px3    px3          8
6 px3    px3          8
```

- but let's undo that...

```
1 df_lifetime <- df_lifetime |>
2   mutate(trial = trial - 5)
```

- what will trial contain?

```
df_lifetime |>
  select(px, new_column, trial) |>
  head()
```

```
# A tibble: 6 x 3
  px    new_column trial
<chr> <chr>      <dbl>
1 px3    px3          1
2 px3    px3          2
3 px3    px3          3
4 px3    px3          3
5 px3    px3          3
6 px3    px3          3
```

`if_else()`

- can be used e.g., inside `mutate()`
 - change values based on some logical condition
 - can be used to change an existing column, or create a new one
- `ifelse(condition, output_if_true, output_if_false)`

```
1 df_lifetime <- df_lifetime |>
2   mutate(new_column = if_else(name=="Aaliyah","name is Aaliyah","name is not Aaliyah"))
```

💡 Logical operators

- symbols used to describe a logical condition
- `==` is identical (`1 == 1`)
- `!=` is not identical (`1 != 2`)
- `>` is greater than (`2 > 1`)
- `<` is less than (`1 < 2`)
- `&` and also (for multiple conditions)
- `|` or (for multiple conditions)

case_when()

- can be used e.g., inside `mutate()`
 - change values based on multiple logical conditions
 - for cases too complex for `ifelse()`
 - can be used to change an existing column, or create a new one
- `case_when(condition & other_condition | other_condition ~ output, TRUE ~ output_otherwise)`
 - if you don't include `TRUE ~ output` then NAs will be created

```
1 df_lifetime <- df_lifetime |>
2   mutate(newer_column = case_when(
3     name=="Aaliyah" & trial > 104 ~ "Aaliyah 2nd half",
4     name=="Beyoncé" & (px == "px01" | px == "px04") ~ "Beyoncé px04 or px06",
5     TRUE ~ "otherwise"))
```

Exercise

1. Create a new variable `accept` that checks whether the button pressed (`KeyPress`) equals the button that corresponds to an acceptance (`yes_press`)
 - if `KeyPress` and `yes_press` are the same, `accept` should be 1. If not, `accept` should be 0
 - hint: you will need `if_else()` or `case_when()`
2. Create a new variable `accuracy` where:
 - if `match` is `yes` and `accept` is 1, `accuracy` is 1
 - if `match` is `no` and `accept` is 0, `accuracy` is 1
 - if `match` is `yes` and `accept` is 0, `accuracy` is 0
 - if `match` is `no` and `accept` is 1, `accuracy` is 0
- if correct, the means and summaries should look like this:

```
mean(df_lifetime$accept)
```

```
[1] 0.6068608
```

```
summary(as_factor(df_lifetime$accept))
```

```
      0      1
1742 2689
```

```
mean(df_lifetime$accuracy)
```

```
[1] 0.6267208
```

```
summary(as_factor(df_lifetime$accuracy))
```

```
      0      1
1654 2777
```

Extra exercise

3. Create a new variable `region`, that has the following values based on `region_n`

- `region_n` 1 is region `verb-1`
- `region_n` 2 is region `verb`
- `region_n` 3 is region `verb+1`
- `region_n` 4 is region `verb+2`
- `region_n` 5 is region `verb+3`
- `region_n` 6 is region `verb+4`

```
summary(as_factor(df_lifetime$region))
```

```
filler verb-1  verb verb+1 verb+2 verb+3 verb+4
1024    639    639    639    639    639    212
```

4. Now relocate our new variables so that:

- `region` is before `region_n`
- `KeyPress` is after `yes_press`

```
names(df_lifetime)
```

```

[1] "px"          "trial"      "region"     "region_n"
[5] "region_text" "eye"        "ff"         "fp"
[9] "rpd"         "tt"         "fix_count"  "reg_in"
[13] "reg_in_count" "reg_out"    "reg_out_count" "rt"
[17] "bio"         "critical"   "gender"     "item_id"
[21] "list"        "match"     "condition"  "name"
[25] "lifetime"    "tense"     "type"       "yes_press"
[29] "KeyPress"    "new_column" "newer_column" "accept"
[33] "accuracy"

```

group_by() and ungroup()

Group data by certain variable(s)

- then perform some mutation
- then ungroup the data

```

df_lifetime <- df_lifetime |>
  group_by(px) |>
  mutate(px_accuracy = mean(accuracy)) |>
  ungroup()

```

```

round(
  range(df_lifetime$px_accuracy),
  2)

```

```
[1] 0.26 0.90
```

.by

- mutate() also takes .by = as an argument
 - does the same thing as group_by()/ungroup()
 - as of dplyr 1.1.0 version ([more info](#))

```

df_lifetime <- df_lifetime |>
  mutate(px_accuracy = mean(accuracy),
         .by = px)

```



```
round(
  range(df_lifetime$px_accuracy),
  2)
```

```
[1] 0.26 0.90
```

separate()

- create new columns from a single column

```
df_lifetime <- df_lifetime |>
  separate(name,
    sep=" ",
    into = c("First","Last"),
    remove = F, # don't remove original column (name)
    extra = "merge") # if extra chunks, combine in 'Last' (von der...)
```

- opposite: `unite()`

select()

- keep only certain column(s)
- often used to preview changes
- if result is saved as an object (`<-`) will remove all other columns
 - so be careful when saving as an already existing object (e.g., `df <- df |> select(...)`)

```
df_lifetime |>
  select(px) |> head(10)
```

```
# A tibble: 10 x 1
  px
<chr>
1 px3
2 px3
3 px3
4 px3
5 px3
6 px3
```

```

7 px3
8 px3
9 px3
10 px3

```

```

df_lifetime |>
  select(px, trial) |> head(10)

```

```
# A tibble: 10 x 2
```

```

  px    trial
  <chr> <dbl>
1 px3      1
2 px3      2
3 px3      3
4 px3      3
5 px3      3
6 px3      3
7 px3      3
8 px3      3
9 px3      4
10 px3     5

```

select(-)

- or remove certain columns

```

df_lifetime |>
  select(-px, -trial) |> head(10)

```

```
# A tibble: 10 x 34
```

	region	region_n	region_text	eye	ff	fp	rp	tt	fix_count	reg_in
	<chr>	<dbl>	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	filler	1	He owned innu~	RIGHT	0	0	0	0	0	0
2	filler	1	She is a moth~	RIGHT	0	0	0	0	0	0
3	verb-1	1	She	RIGHT	0	0	0	0	0	0
4	verb	2	will perform	RIGHT	0	0	0	0	0	0
5	verb+1	3	in prestigiou~	RIGHT	0	0	0	0	0	0
6	verb+2	4	in the future,	RIGHT	0	0	0	0	0	0
7	verb+3	5	as reported i~	RIGHT	0	0	0	0	0	0
8	verb+4	6	as reported i~	RIGHT	0	0	0	0	0	0

```

 9 filler          1 He interviewe~ RIGHT    0    0    0    0    0    0
10 verb-1          1 She                RIGHT    0    0    0    0    0    0
# i 24 more variables: reg_in_count <dbl>, reg_out <dbl>, reg_out_count <dbl>,
#   rt <dbl>, bio <chr>, critical <chr>, gender <chr>, item_id <dbl>,
#   list <dbl>, match <chr>, condition <chr>, name <chr>, First <chr>,
#   Last <chr>, lifetime <chr>, tense <chr>, type <chr>, yes_press <dbl>,
#   KeyPress <dbl>, new_column <chr>, newer_column <chr>, accept <dbl>,
#   accuracy <dbl>, px_accuracy <dbl>

```

Select criteria

You can also use criteria for `select`:

- `select(starts_with("x"))` select columns that start with a character string
- `select(ends_with("x"))` select columns that end with a character string
- `select(contains("x"))` select columns that contain a character string
- `select(num_range("prefix",10:20))` select columns with a **prefix** followed by a range of values

Exercise

Remove the example variables we created with `mutate`:

- `new_column`, `newer_column`, `First`, `Last`

```

# should look like this after
names(df_lifetime)

```

```

[1] "px"          "trial"       "region"      "region_n"
[5] "region_text" "eye"         "ff"          "fp"
[9] "rpd"         "tt"         "fix_count"   "reg_in"
[13] "reg_in_count" "reg_out"     "reg_out_count" "rt"
[17] "bio"         "critical"    "gender"      "item_id"
[21] "list"        "match"      "condition"   "name"
[25] "lifetime"    "tense"      "type"        "yes_press"
[29] "KeyPress"    "accept"     "accuracy"    "px_accuracy"

```

Wrangling rows

filter()

- select certain rows based on certain criteria
 - requires logical operators (==, !=, >, <, |)
 - N.B. when testing logical conditions == is needed

```
1 df_lifetime |>
2   filter(trial == 1)
```

A tibble: 8 x 32

	px	trial	region	region_n	region_text	eye	ff	fp	rpd	tt
	<chr>	<dbl>	<chr>	<dbl>	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>
1	px3	1	filler	1	He owned innumerabl~	RIGHT	0	0	0	0
2	px5	1	filler	1	She is a mother of ~	RIGHT	145	1603	1603	1603
3	px6	1	filler	1	He is a father of t~	RIGHT	147	1224	1224	1224
4	px2	1	filler	1	She made innumerabl~	RIGHT	84	1829	1829	1829
5	px7	1	filler	1	In the '70s, he own~	RIGHT	138	2456	2456	2456
6	px1	1	filler	1	Beloved morning sho~	RIGHT	160	1708	1708	1708
7	px8	1	filler	1	She was a mother of~	RIGHT	220	806	806	806
8	px4	1	filler	1	In the '70s, he own~	LEFT	171	3557	3557	3557

i 22 more variables: fix_count <dbl>, reg_in <dbl>, reg_in_count <dbl>,
reg_out <dbl>, reg_out_count <dbl>, rt <dbl>, bio <chr>, critical <chr>,
gender <chr>, item_id <dbl>, list <dbl>, match <chr>, condition <chr>,
name <chr>, lifetime <chr>, tense <chr>, type <chr>, yes_press <dbl>,
KeyPress <dbl>, accept <dbl>, accuracy <dbl>, px_accuracy <dbl>

filter()

What are these code chunks doing?

```
1 df_lifetime |>
2   filter(px_accuracy > .5)
```

```
1 df_lifetime |>
2   filter(px == "px3")
```

```
1 df_lifetime |>
2   filter(px == "px3" | trial == "3")
```

```
1 df_lifetime |>
2   filter(px == "px3" & trial != "3")
```

Exercise

1. Create a new dataframe `df_crit` that includes only critical trials
 2. Create a new dataframe `df_fill` that includes only filler trials
- Tip: trial type is stored in the column `type`

```
df_crit |> select(type) |> head()
```

```
# A tibble: 6 x 1
  type
<chr>
1 critical
2 critical
3 critical
4 critical
5 critical
6 critical
```

```
df_fill |> select(type) |> head()
```

```
# A tibble: 6 x 1
  type
<chr>
1 filler
2 filler
3 filler
4 filler
5 filler
6 filler
```

`distinct()`

- like `filter()`, but for *distinct values* of a variable
 - “select rows with distinct values for some row(s)”

```
1 df_crit |>
2   distinct(px)
```

```
# A tibble: 8 x 1
  px
<chr>
1 px3
2 px5
3 px6
4 px2
5 px7
6 px1
7 px8
8 px4
```

```
1 df_crit |>
2   distinct(px, name)
```

```
# A tibble: 639 x 2
  px      name
<chr> <chr>
1 px3 Edith Piaf
2 px3 Aaliyah
3 px3 David Beckham
4 px3 Jana Novotna
5 px3 Grace Kelly
6 px3 Nigella Lawson
7 px3 Coco Chanel
8 px3 Ben Kingsley
9 px3 Jim Carrey
10 px3 Judy Garland
# i 629 more rows
```

```
1 df_crit |>
2   distinct(px, name,
3             .keep_all=T)
```

```
# A tibble: 639 x 32
  px    trial region region_n region_text eye    ff    fp    rpd    tt
  <chr> <dbl> <chr>      <dbl> <chr>      <chr> <dbl> <dbl> <dbl> <dbl>
1 px3      3 verb-1      1 She      RIGHT    0     0     0     0
2 px3      5 verb-1      1 She      RIGHT    0     0     0     0
3 px3      8 verb-1      1 He       RIGHT    0     0     0     0
4 px3     10 verb-1      1 She      RIGHT    0     0     0     0
5 px3     13 verb-1      1 She      RIGHT    0     0     0     0
6 px3     16 verb-1      1 She      RIGHT    0     0     0     0
7 px3     18 verb-1      1 She      RIGHT    0     0     0     0
8 px3     21 verb-1      1 He       RIGHT    0     0     0     0
9 px3     23 verb-1      1 He       RIGHT    0     0     0     0
10 px3     26 verb-1      1 She      RIGHT    0     0     0     0
# i 629 more rows
# i 22 more variables: fix_count <dbl>, reg_in <dbl>, reg_in_count <dbl>,
#   reg_out <dbl>, reg_out_count <dbl>, rt <dbl>, bio <chr>, critical <chr>,
#   gender <chr>, item_id <dbl>, list <dbl>, match <chr>, condition <chr>,
#   name <chr>, lifetime <chr>, tense <chr>, type <chr>, yes_press <dbl>,
#   KeyPress <dbl>, accept <dbl>, accuracy <dbl>, px_accuracy <dbl>
```

arrange()

- sort column(s) in ascending or descending order
 - this is really just for ease of reading

```
# default: ascending order (A-Z)
df_crit |>
  distinct(px, trial, name, condition) |>
  arrange(px, trial)
```

```
# A tibble: 639 x 4
  px    trial name          condition
  <chr> <dbl> <chr>          <chr>
1 px1      3 Amy Winehouse  deadPP
2 px1      5 John Wayne    deadPP
3 px1      8 Abraham Lincoln deadPP
4 px1     10 Helen Mirren    livingSF
5 px1     13 Paul McCartney livingSF
6 px1     16 Ariana Grande livingPP
7 px1     18 Kate Middleton livingSF
8 px1     21 Johan Cruyff deadSF
```

```

 9 px1      23 Marilyn Monroe  deadPP
10 px1      26 Biggie Smalls   deadSF
# i 629 more rows

```

```

# descending order (Z-A)
df_crit |>
  distinct(px, trial, name, condition) |>
  arrange(desc(px), trial)

```

```

# A tibble: 639 x 4
   px      trial name      condition
  <chr> <dbl> <chr>      <chr>
1 px8      3 Whitney Houston deadPP
2 px8      5 Elton John   livingSF
3 px8      8 Jackie Chan   livingPP
4 px8     10 Romy Schneider deadPP
5 px8     13 James Cameron livingSF
6 px8     16 Ella Fitzgerald deadSF
7 px8     18 Kathryn Hepburn deadPP
8 px8     21 Kate Middleton livingPP
9 px8     23 Janis Joplin  deadPP
10 px8     26 Serena Williams livingSF
# i 629 more rows

```

Save your tidy data

- once your data is nice and tidy, save it with a **new filename**
 - this way you always have the same starting point for your data exploration/analyses

```

# run this manually!
write.csv(df_lifetime, here::here("data/tidy_data_lifetime_pilot.csv"), row.names=FALSE)

```

Summary

- we saw that the equation for a straight line boils down to its intercept and slope
- we fit our first linear model with a categorical predictor
- next, we'll look at a case with more than one predictor: **multiple** regression

Important terms

wrangle	have a long dispute
data wrangling	tidying and transforming your data
tidy data	data where each column is a variable and each row is an observation
the tidyverse	a group of packages for tidy data
dplyr	a package within the tidyverse for data wrangling
pipe operator (<code> ></code> or <code> ></code>)	operational function, passes the result of one function/argument to the next
logical operators	compare values of two arguments: <code>&</code> , <code> </code> , <code>==</code> , <code>!=</code> , <code>></code> , <code><</code>

Important functions

<code>read_csv()</code>	read-in a csv as a tibble (from readr package)
<code>rename()</code>	rename variables
<code>relocate()</code>	move variables
<code>mutate()</code>	change or create new variables
<code>if_else()</code>	condition for 'mutate()'
<code>case_when()</code>	handle multiple conditions for 'mutate()'
<code>group_by()</code>	group by a certain variable
<code>select()</code>	keep (or exclude) certain variables
<code>filter()</code>	keep (or exclude) rows based on some criteria
<code>distinct()</code>	keep rows with distinct value of given variable(s)
<code>arrange()</code>	sort variable(s) in ascending or descending order
<code>separate()</code>	split a variable into multiple variables
<code>pivot_longer()</code>	make wide data longer
<code>pivot_wider()</code>	make long data wider

Session Info

```
sessionInfo()
```

```
R version 4.4.0 (2024-04-24)
Platform: aarch64-apple-darwin20
Running under: macOS Ventura 13.2.1
```

```

Matrix products: default
BLAS: /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRblas.0.dylib
LAPACK: /Library/Frameworks/R.framework/Versions/4.4-arm64/Resources/lib/libRlapack.dylib;

locale:
[1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8

time zone: Europe/Berlin
tzcode source: internal

attached base packages:
[1] stats      graphics  grDevices datasets  utils      methods    base

other attached packages:
[1] lubridate_1.9.3 forcats_1.0.0  stringr_1.5.1  dplyr_1.1.4
[5] purrr_1.0.2     readr_2.1.5    tidyr_1.3.1    tibble_3.2.1
[9] ggplot2_3.5.1   tidyverse_2.0.0 magick_2.8.3

loaded via a namespace (and not attached):
[1] bit_4.0.5          gtable_0.3.5      jsonlite_1.8.8    crayon_1.5.2
[5] compiler_4.4.0     renv_1.0.7        tidyselect_1.2.1  Rcpp_1.0.12
[9] parallel_4.4.0     scales_1.3.0      yaml_2.3.8        fastmap_1.2.0
[13] here_1.0.1         R6_2.5.1          generics_0.1.3    knitr_1.47
[17] munsell_0.5.1      rprojroot_2.0.4   tzdb_0.4.0        pillar_1.9.0
[21] rlang_1.1.4        utf8_1.2.4        stringi_1.8.4     xfun_0.44
[25] bit64_4.0.5        timechange_0.3.0  cli_3.6.2         withr_3.0.0
[29] magrittr_2.0.3     digest_0.6.35     grid_4.4.0        vroom_1.6.5
[33] rstudioapi_0.16.0  hms_1.1.3         lifecycle_1.0.4   vctrs_0.6.5
[37] evaluate_0.23      glue_1.7.0        fansi_1.0.6       colorspace_2.1-0
[41] rmarkdown_2.27     tools_4.4.0       pkgconfig_2.0.3   htmltools_0.5.8.1

```

Laurinavichyute, A., Yadav, H., & Vasisht, S. (2022). Share the code, not just the data: A case study of the reproducibility of articles published in the Journal of Memory and Language under the open data policy. *Journal of Memory and Language*, 125, 12.

Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). *R for Data Science* (2nd ed.).

Winter, B. (2019). Statistics for Linguists: An Introduction Using R. In *Statistics for Linguists: An Introduction Using R*. Routledge. <https://doi.org/10.4324/9781315165547>