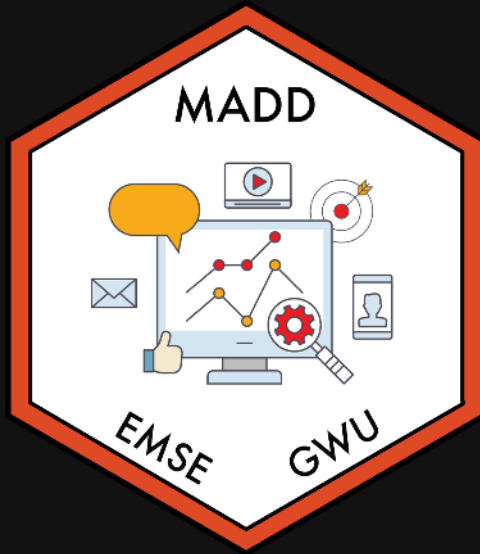




Week 3: *Quarto & Plotting*

 EMSE 6035: Marketing Analytics for Design Decisions

 John Paul Helveston

 September 10, 2025

Week 3: *Quarto & Plotting*

1. Intro to Quarto

2. Intro to ggplot2

Break

3. Project attributes & levels

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"Literate programming"

Treat programs as a
"literature" understandable
to **human beings**



Donald E. Knuth

Quick demo

1. Open `quarto_demo.qmd`
2. Click "Render"



Anatomy of a .qmd file

Header

Markdown text

R code

Define overall document options in header

Basic html page

```
---  
title: Your title  
author: Author name  
format: html  
---
```

Add table of contents, change theme

```
---  
title: Your title  
author: Author name  
toc: true  
format:  
  html:  
    theme: united  
---
```

More on themes at

<https://quarto.org/docs/output-formats/html-themes.html>

Render to multiple outputs

PDF uses LaTeX

```
---  
title: Your title  
author: Author name  
format: pdf  
---
```

Microsoft Word

```
---  
title: Your title  
author: Author name  
format: docx  
---
```

If you don't have LaTeX on your computer,
install tinytex in R:

```
tinytex::install_tinytex()
```

Anatomy of a .qmd file

~~Header~~

Markdown text

R code

Right now, bookmark this! 📌

<https://commonmark.org/help/>

(When you have 10 minutes, do this! 📌)

<https://commonmark.org/help/tutorial/>

Headers

HEADER 1

HEADER 2

HEADER 3

HEADER 4

HEADER 5

HEADER 6

HEADER 1

HEADER 2

HEADER 3

HEADER 4

HEADER 5

HEADER 6

Basic Text Formatting

Type this...

- normal text
- *_italic text_*
- **italic text**
- ****bold text****
- *****bold italic text*****
- ~~~~strikethrough~~~~
- ``code text``

..to get this

- normal text
- *italic text*
- *italic text*
- **bold text**
- ***bold italic text***
- ~~strikethrough~~
- `code text`

Lists

Bullet list:

- first item
- second item
- third item

- first item
- second item
- third item

Numbered list:

1. first item
2. second item
3. third item

1. first item
2. second item
3. third item

Links

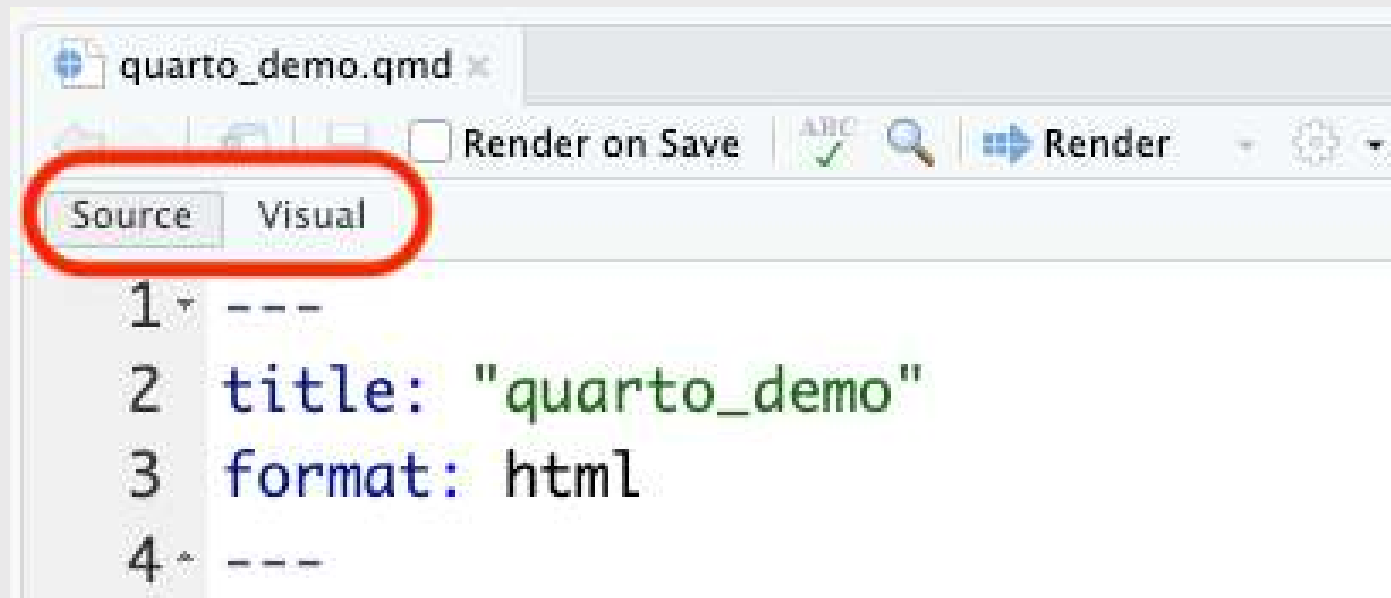
Simple **url link** to another site:

[Download R] (<http://www.r-project.org/>)

[Download R](http://www.r-project.org/)

Don't want to use Markdown?

Use Visual Mode!



Anatomy of a .qmd file

~~Header (think of this as the "settings")~~

~~Markdown text~~

R code

R Code

Inline code

```
`r insert code here`
```

Code chunks

```
```${r}  
insert code here
insert more code here
```
```

Inline R code

```
The sum of 3 and 4 is `r 3 + 4`
```

Produces this:

The sum of 3 and 4 is 7

R Code chunks

This code chunk...

```
```{r}
library(palmerpenguins)

head(penguins)
```
```

...will produce this when compiled:

```
library(palmerpenguins)

head(penguins)
```

```
#> # A tibble: 6 × 8
#>   species island    bill_length_mm
bill_depth_mm flipper_length_mm
body_mass_g sex      year
#>   <fct>    <fct>          <dbl>
<dbl>          <int>      <int> <fct>
<int>
#> 1 Adelie  Torgersen          39.1
18.7              181      3750 male
2007
#> 2 Adelie  Torgersen          39.5
17.4              186      3800 female
2007
#> 3 Adelie  Torgersen          40.3
```

Chunk options

Control what chunks output using options

All options [here](#)

| option | default | effect |
|------------|----------|---|
| eval | TRUE | Whether to evaluate the code and include its results |
| echo | TRUE | Whether to display code along with its results |
| warning | TRUE | Whether to display warnings |
| error | FALSE | Whether to display errors |
| message | TRUE | Whether to display messages |
| tidy | FALSE | Whether to reformat code in a tidy way when displaying it |
| results | "markup" | "markup", "asis", "hold", or "hide" |
| cache | FALSE | Whether to cache results for future renders |
| comment | "##" | Comment character to preface results with |
| fig.width | 7 | Width in inches for plots created in chunk |
| fig.height | 7 | Height in inches for plots created in chunk |

Chunk output options

By default, code chunks print **code** + **output**

```
```${r}  
#| echo: false

cat('hello world!')
```
```

Prints only **output**
(doesn't show code)

```
#> hello world!
```

```
```${r}  
#| eval: false

cat('hello world!')
```
```

Prints only **code**
(doesn't run the code)

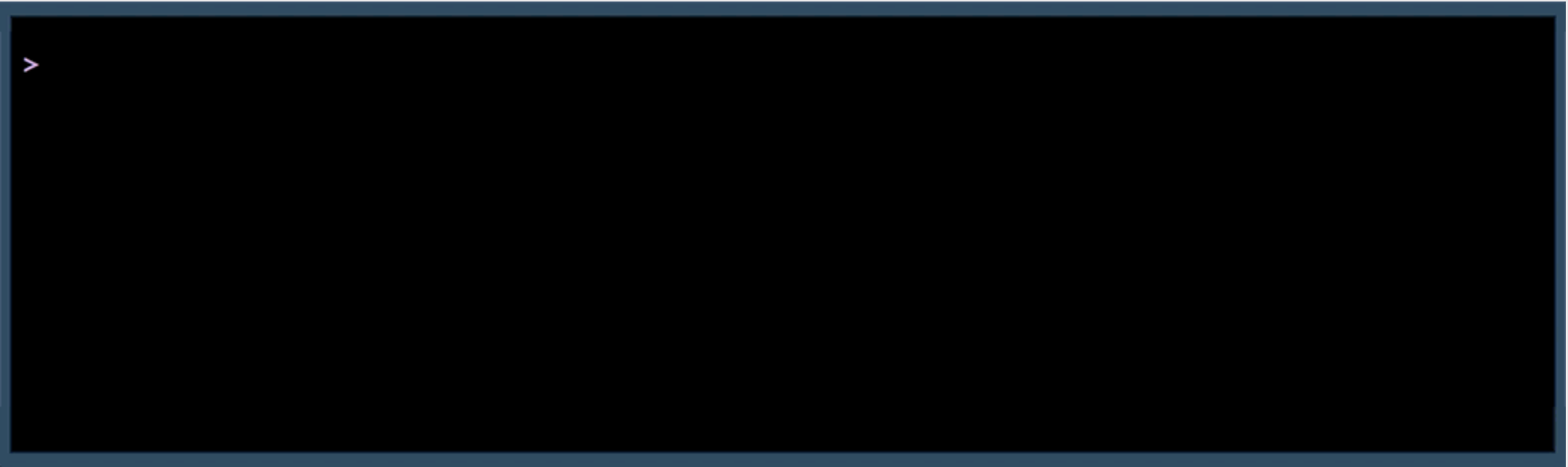
```
cat('hello world!')
```

```
```${r}  
#| include: false

cat('hello world!')
```
```

Runs, but doesn't print
anything

message / warning



>

message / warning

Drop messages and warnings in chunk settings

```
```\r}\n#| message: false\n#| warning: false\n\nlibrary(tidyverse)\n```
```

# A global `setup` chunk 🌍

```
```\{r}  
#| label: setup  
#| include: false  
  
knitr::opts_chunk$set(  
  warning = FALSE,  
  message = FALSE,  
  fig.path = "figs/",  
  fig.width = 7.252,  
  fig.height = 4,  
  comment = "#>",  
  fig.retina = 3  
)  
```
```

- Typically the first chunk
- All following chunks will use these options (i.e., sets global chunk options)
- You can (and should) use individual chunk options too
- Often where I load libraries, etc.

# Your turn

15:00

- 1) Open the `bears.qmd` file, and title it *"Bears Analysis"*
- 2) Create a "setup" code chunk to read in the `bear_killings.csv` data file (HINT: You might want to look back at the `quarto_demo.qmd` file!).
- 3) Use text and code to find answers each of the following questions - show your code and results to justify each answer:
  - Which months have the highest frequency of bear killings?
  - Who has been killed more often by bears: hunters or hikers?
  - How do the the number of bear attacks on men vs women compare?

HINT: Use `bears %>% count(variable)` to count how many rows are in the data for each unique value of `variable`

# Week 3: *Quarto & Plotting*

1. Intro to Quarto

2. Intro to ggplot2

Break

3. Project attributes & levels

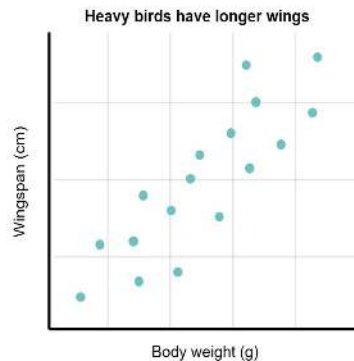
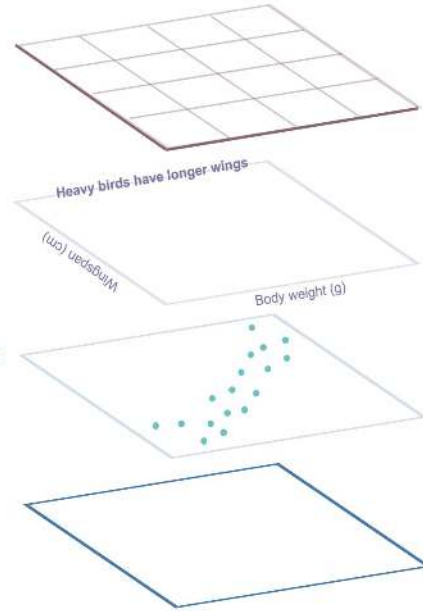
## MAKING A GRAPH WITH GGPLOT2

Customise the look of your plot with themes  
(pre-made or your own!):  
`+ theme_bw()`

Add labels and titles:  
`+ labs(x = "Body weight (g)", y = "Wingspan (cm)",  
title = "Heavy birds have longer wings")`

Specify the type of graph and the variables to use:  
`+ geom_point(aes(x = body.weight, y = wingspan))`

Plot the device containing your data:  
`ggplot(data = birds)`



# "Grammar of Graphics"

Concept developed by Leland Wilkinson  
(1999)

**ggplot2** package developed by Hadley  
Wickham (2005)

# Making plot layers with ggplot2

1. The data
2. The aesthetic mapping (what goes on the axes?)
3. The geometries (points? bars? etc.)
4. The annotations / labels
5. The theme

# Layer 1: The data

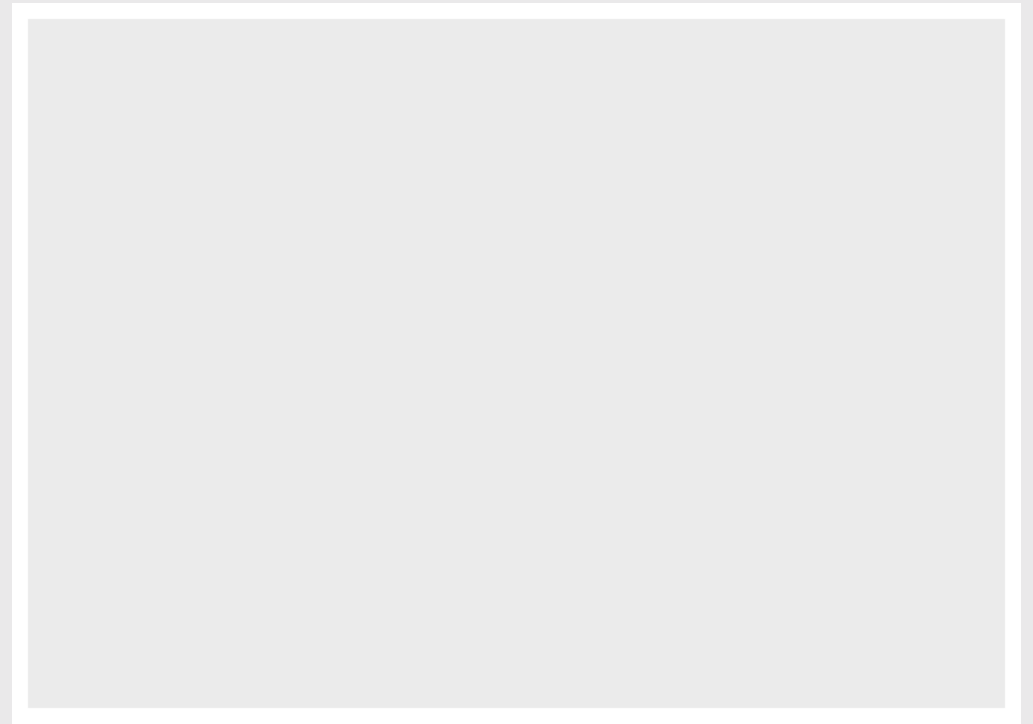
```
head(mpg)
```

```
#> # A tibble: 6 × 11
#> manufacturer model displ year cyl trans drv cty hwy fl class
#> <chr> <chr> <dbl> <int> <int> <chr> <chr> <int> <int> <chr> <chr>
#> 1 audi a4 1.8 1999 4 auto(l5) f 18 29 p compact
#> 2 audi a4 1.8 1999 4 manual(m5) f 21 29 p compact
#> 3 audi a4 2 2008 4 manual(m6) f 20 31 p compact
#> 4 audi a4 2 2008 4 auto(av) f 21 30 p compact
#> 5 audi a4 2.8 1999 6 auto(l5) f 16 26 p compact
#> 6 audi a4 2.8 1999 6 manual(m5) f 18 26 p compact
```

# Layer 1: The data

The `ggplot()` function initializes the plot with whatever data you're using

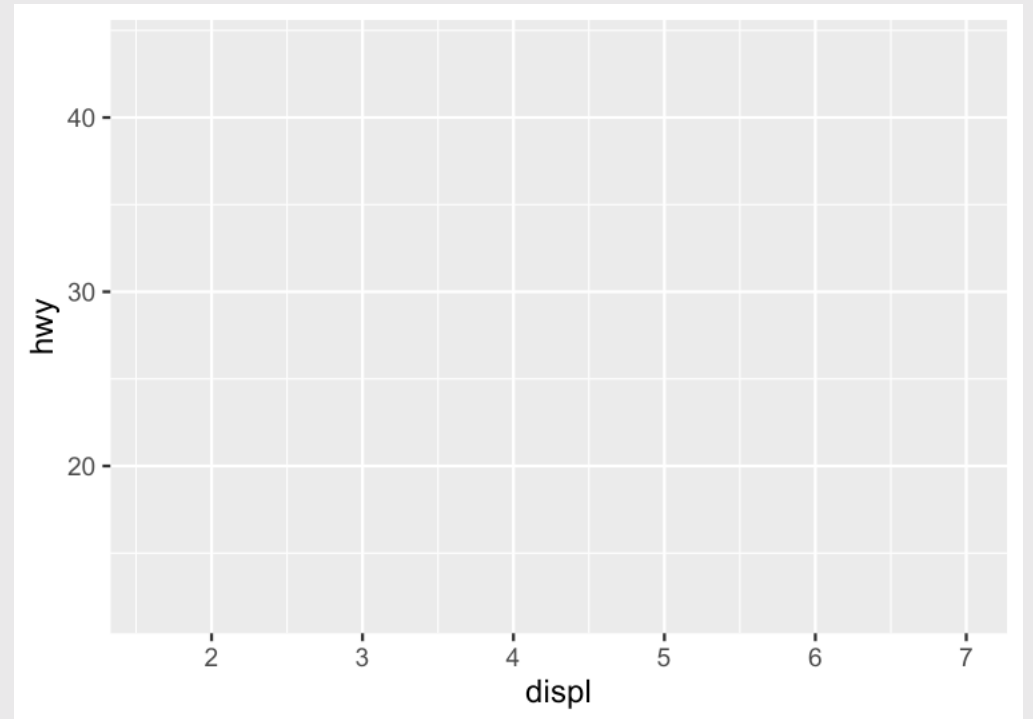
```
mpg %>%
 ggplot()
```



# Layer 2: The aesthetic mapping

The `aes()` function determines which variables will be *mapped* to the geometries (e.g. the axes)

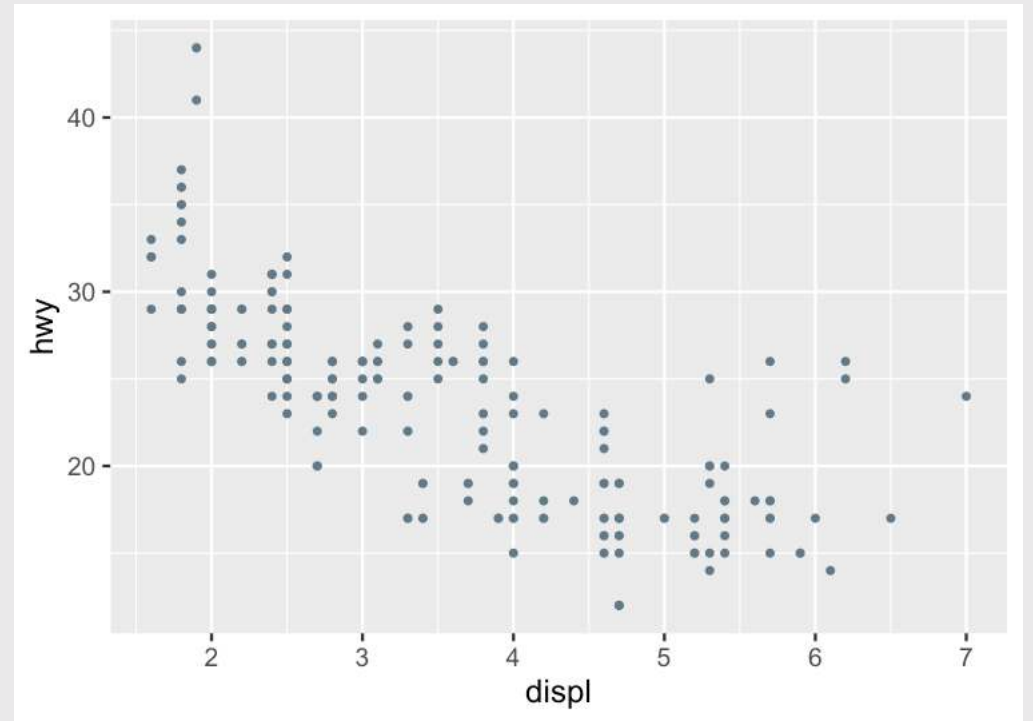
```
mpg %>%
 ggplot(aes(x = displ, y = hwy))
```



# Layer 3: The geometries

Use `+` to add geometries, e.g. `geom_points()` for points

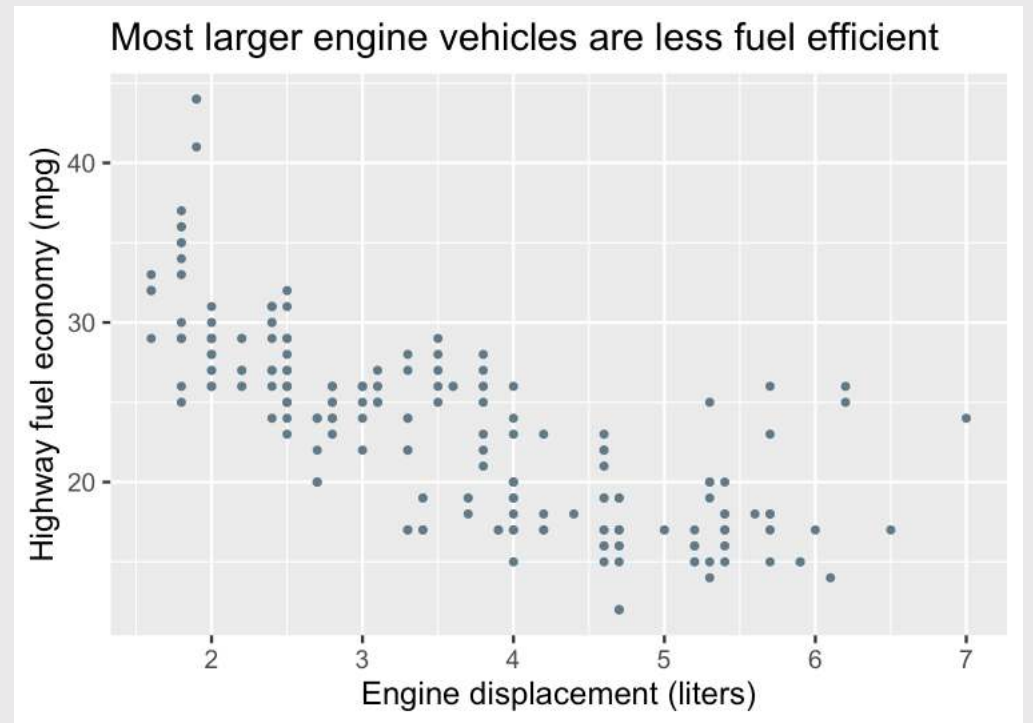
```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point()
```



# Layer 4: The annotations / labels

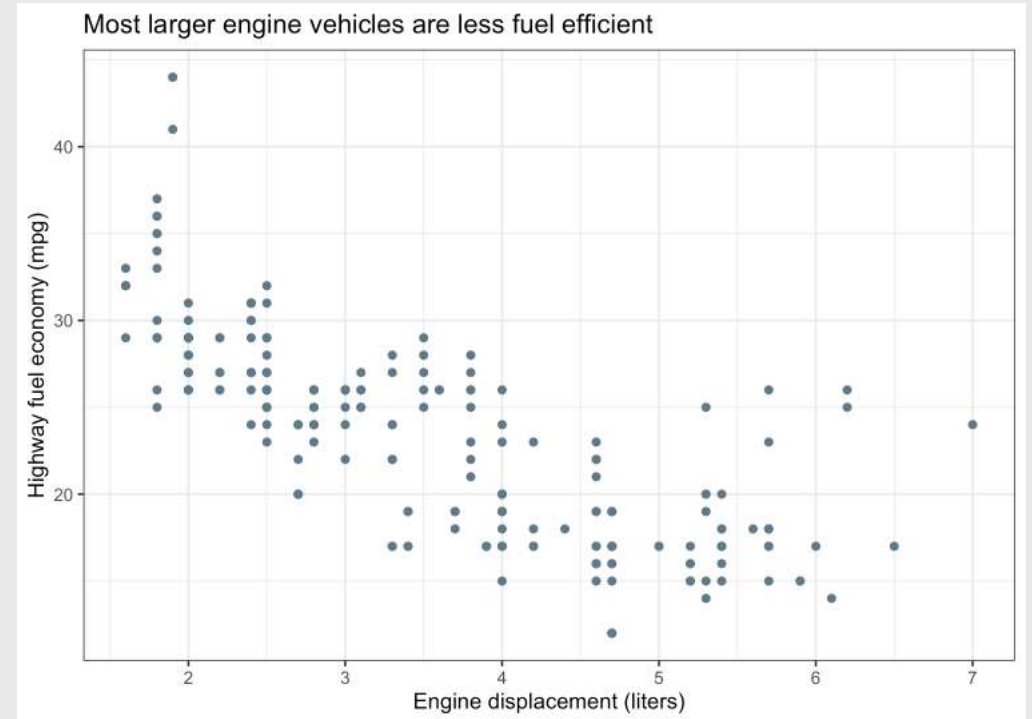
Use `labs()` to modify most labels

```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 labs(
 x = "Engine displacement (liters)",
 y = "Highway fuel economy (mpg)",
 title = "Most larger engine vehicles
are less fuel efficient"
)
```



# Layer 5: The theme

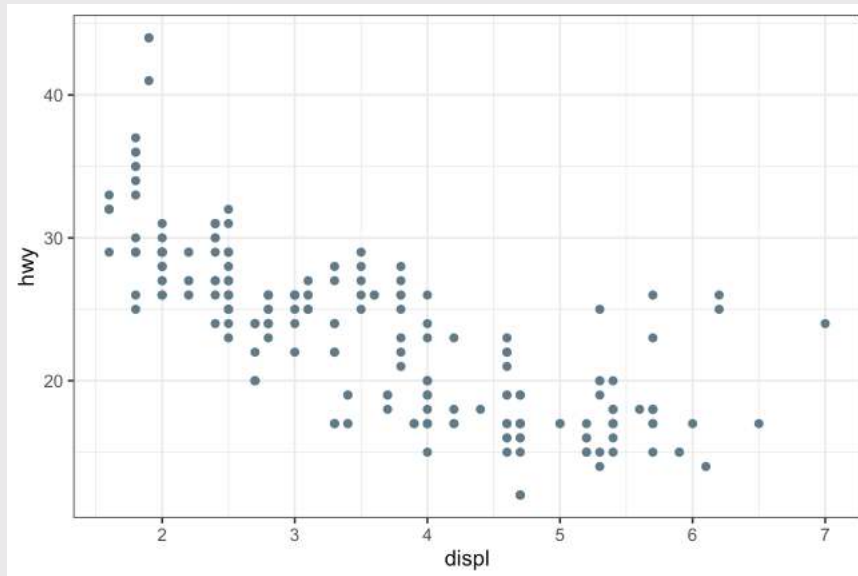
```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 labs(
 x = "Engine displacement (liters)",
 y = "Highway fuel economy (mpg)",
 title = "Most larger engine vehicles
are less fuel efficient"
) +
 theme_bw()
```



# Common themes

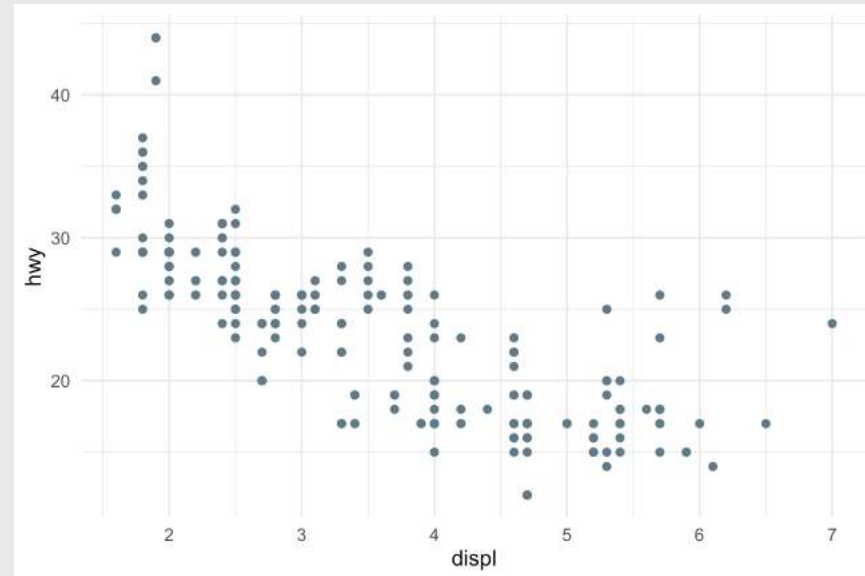
## theme\_bw()

```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 theme_bw()
```



## theme\_minimal()

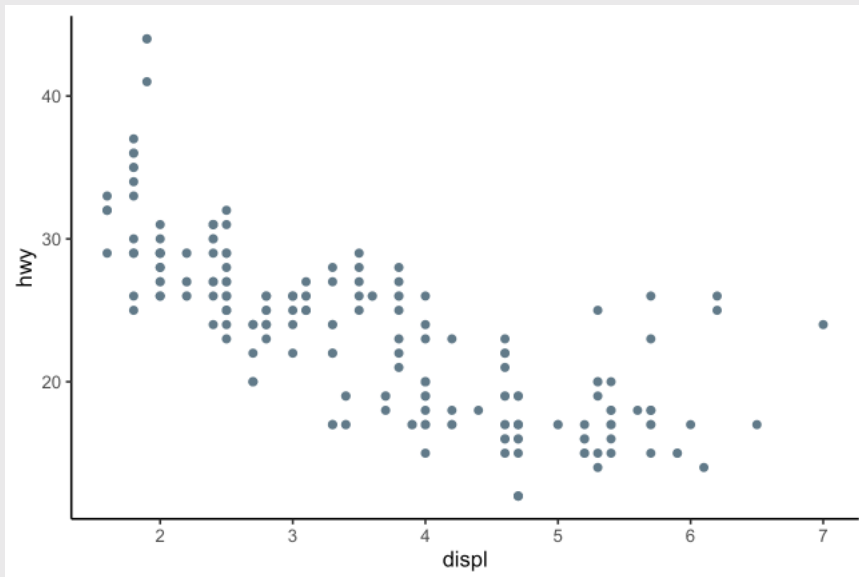
```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 theme_minimal()
```



# Common themes

## theme\_classic()

```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 theme_classic()
```



## theme\_void()

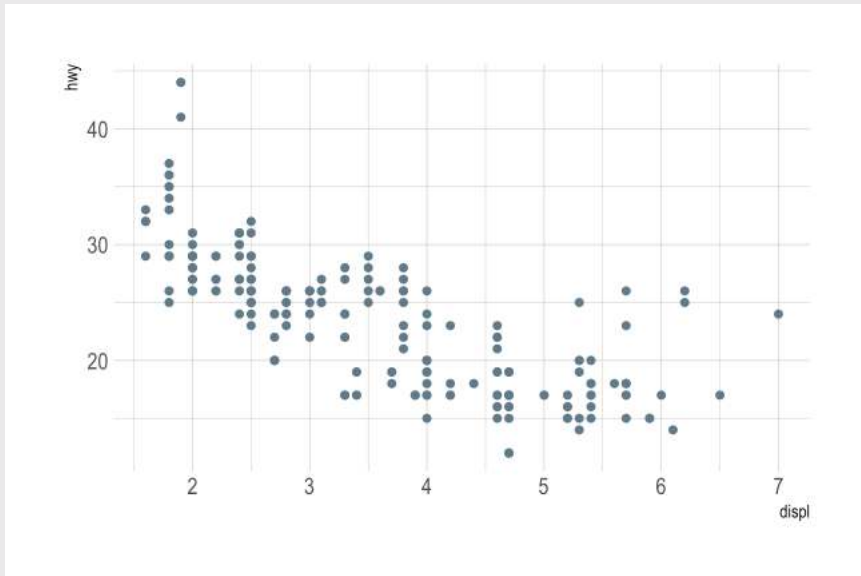
```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 theme_void()
```



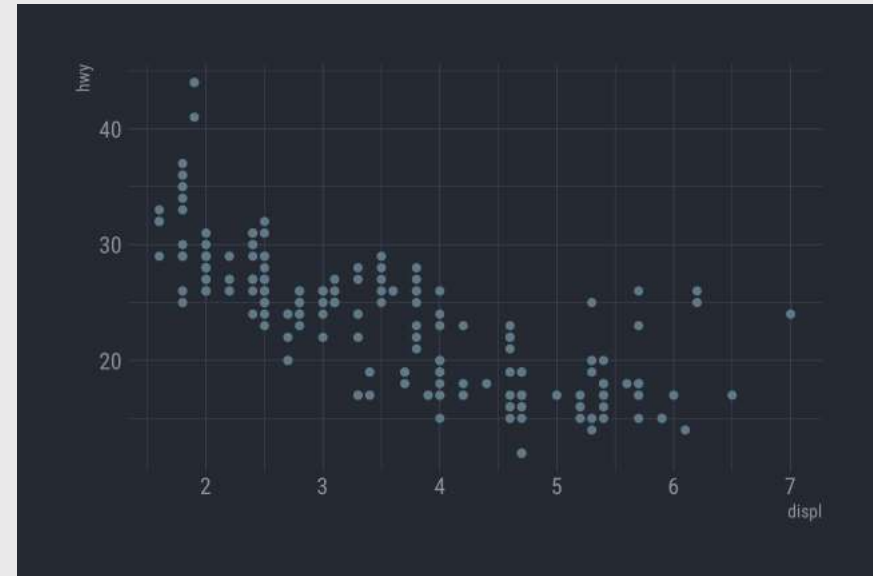
## Other themes: [hrbrthemes](#)

```
remotes::install_github("hrbrmstr/hrbrthemes")
```

```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 hrbrthemes::theme_ipsum()
```



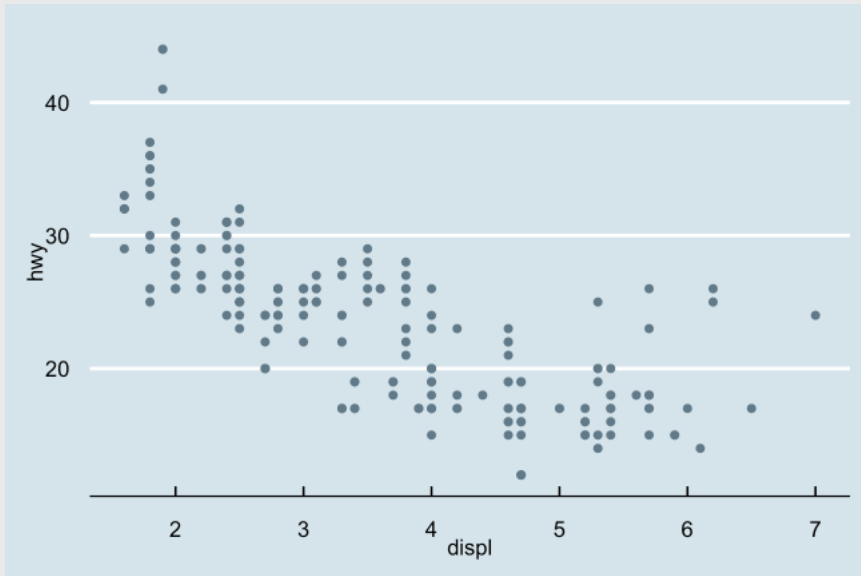
```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 hrbrthemes::theme_ft_rc()
```



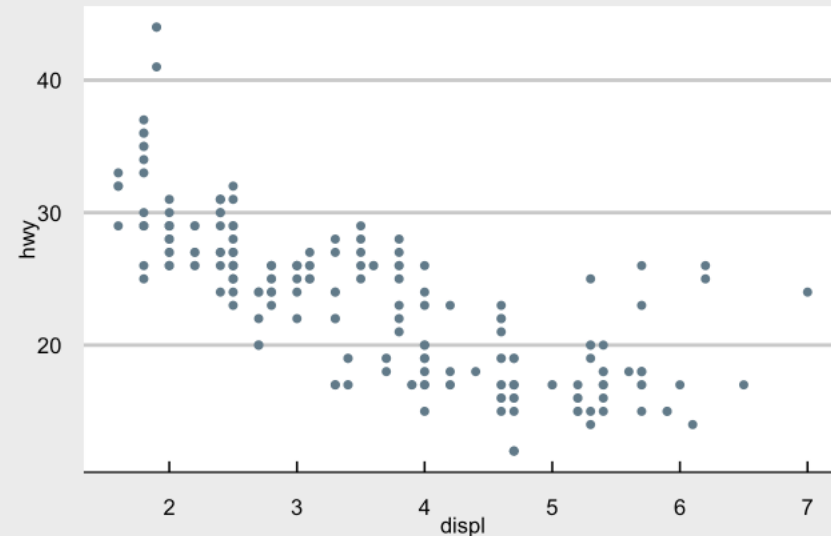
## Other themes: `ggthemes`

```
install.packages('ggthemes', dependencies = TRUE)
```

```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 ggthemes::theme_economist()
```



```
mpg %>%
 ggplot(aes(x = displ, y = hwy)) +
 geom_point() +
 ggthemes::theme_economist_white()
```



More practice

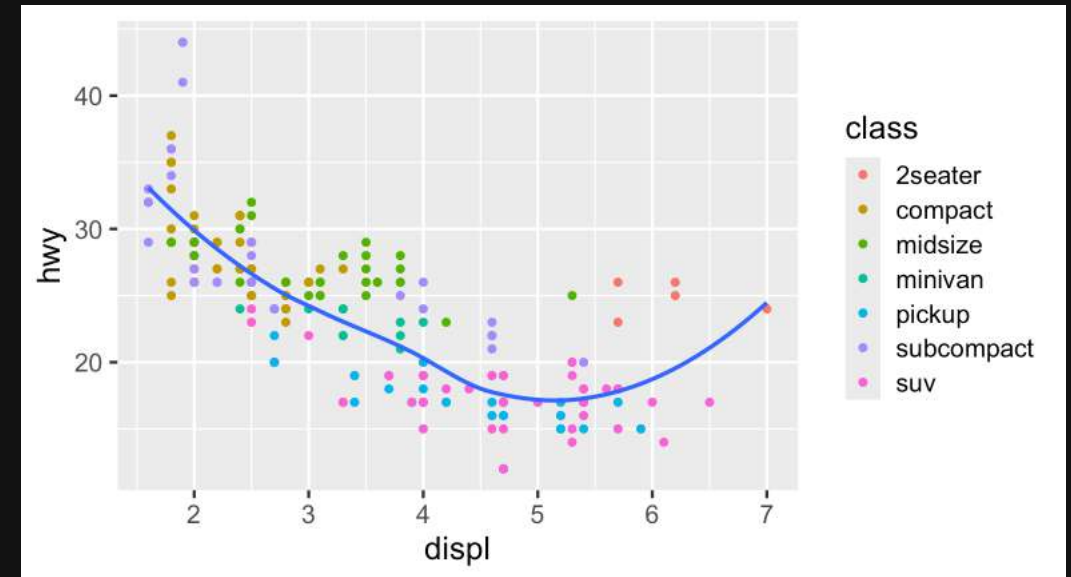
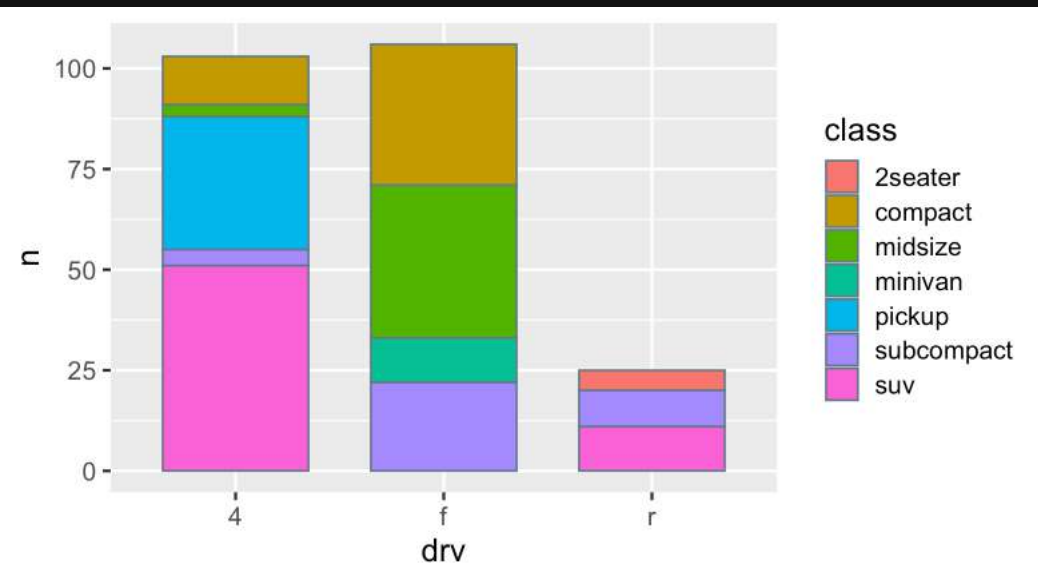
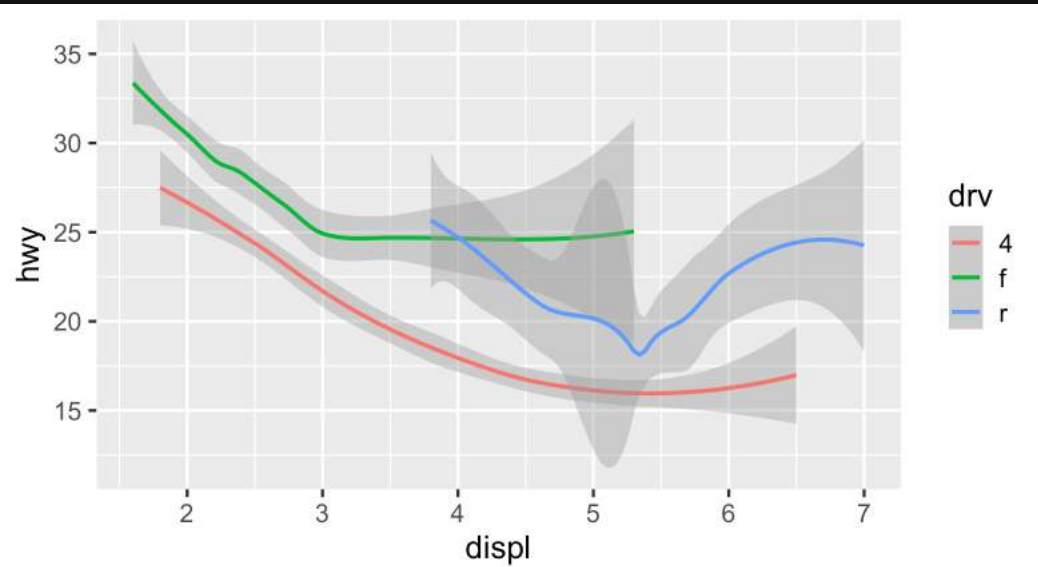
Open `ggplot2.qmd`

15:00

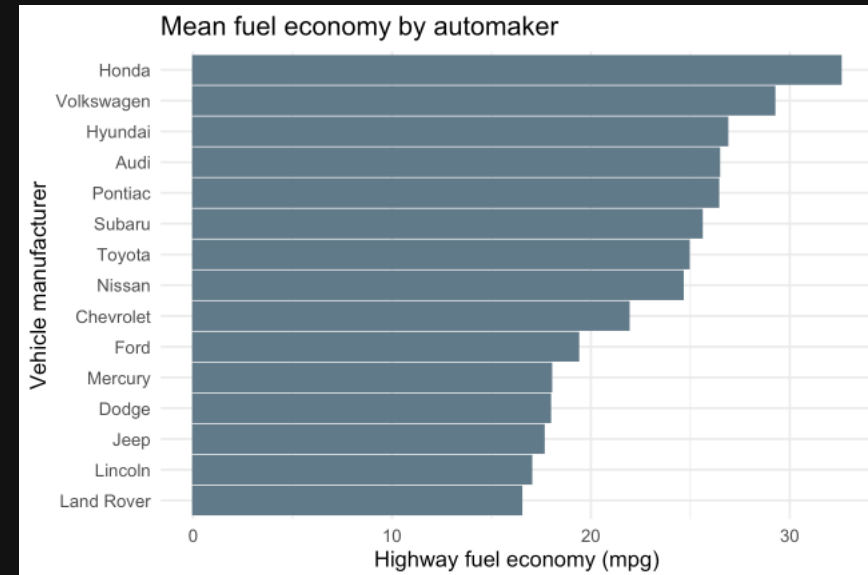
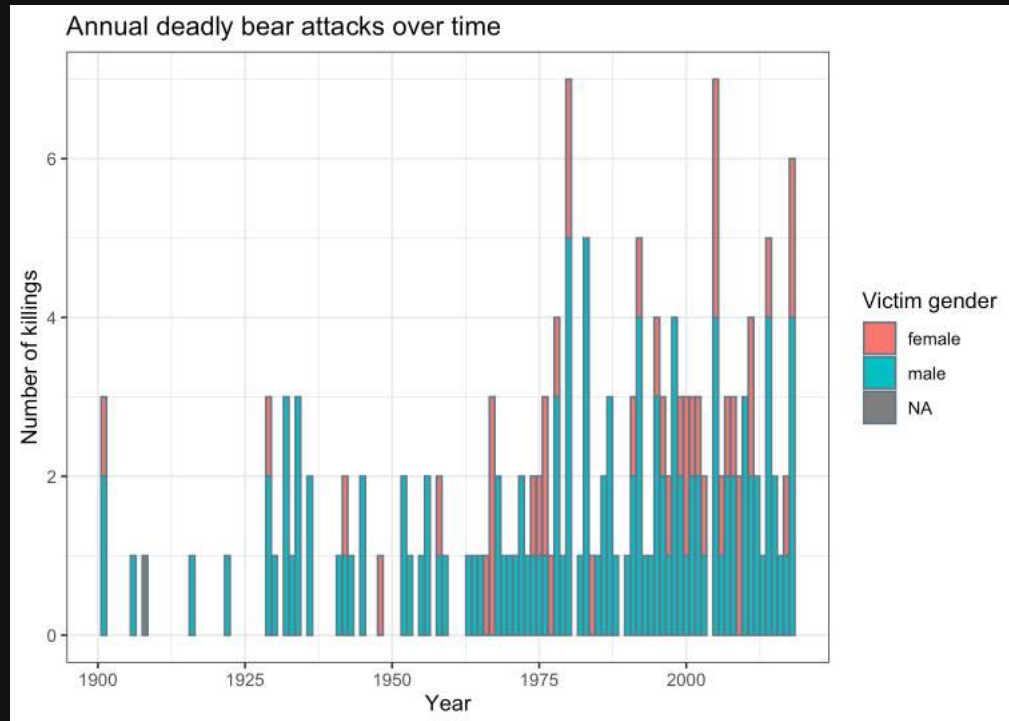
## Your turn

Open `practice.qmd`

Use the `mpg` data frame and ggplot to create these charts



# Extra practice



# Week 3: *Quarto & Plotting*

1. Intro to Quarto

2. Intro to ggplot2

Break

3. Project attributes & levels

# Model Relationships Table (example)

|                           |              | <i>Features</i> |                 |        | <i>Competitors</i> |                      |
|---------------------------|--------------|-----------------|-----------------|--------|--------------------|----------------------|
|                           |              | Range           | Units           | Demand | Aims Solar Panel   | SUAOKI Solar Charger |
| <i>Product Attributes</i> | Price        | \$60 - \$225    | USD / kW        | -      | 225                | 160                  |
|                           | Weight       | 1 - 3           | kg              | -      | 2.6                | 2.06                 |
|                           | Power Output | 100 - 500       | W               | +      | 120                | 60                   |
|                           | Durability   | 12 - 60         | months          | +      | 60                 | 12                   |
|                           | Portability  | 200 - 2800      | cm <sup>3</sup> | +      | 20.6"x11"x 1.2"    | 11.5"x7.1"x2.9"      |

Start defining attribute *levels*

# Defining attribute levels

## Continuous

- **Price:** 1, 2, 3, 4, 5 (\$)
- **Power Output:** 60, 80, 120 (Watts)

- Look at competitors
- Search web for values that cover the full set of values available today (and maybe some into the future)

## Discrete

- **Color:** Red, Blue, Yellow
- **Material:** Plastic, Aluminum, Glass

# Reminders:

- You have **11** days until your [Project Proposal](#) is due.
- Next week: **Project Proposal Meetings** - sign up [HERE](#)