



Week 3: *Quarto & Plotting*

 EMSE 6035: Marketing Analytics for Design Decisions

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Week 3: *Quarto & Plotting*

1. Intro to Quarto

QUIZ 1

2. Intro to ggplot2

3. Project attributes & levels

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"Literate programming"

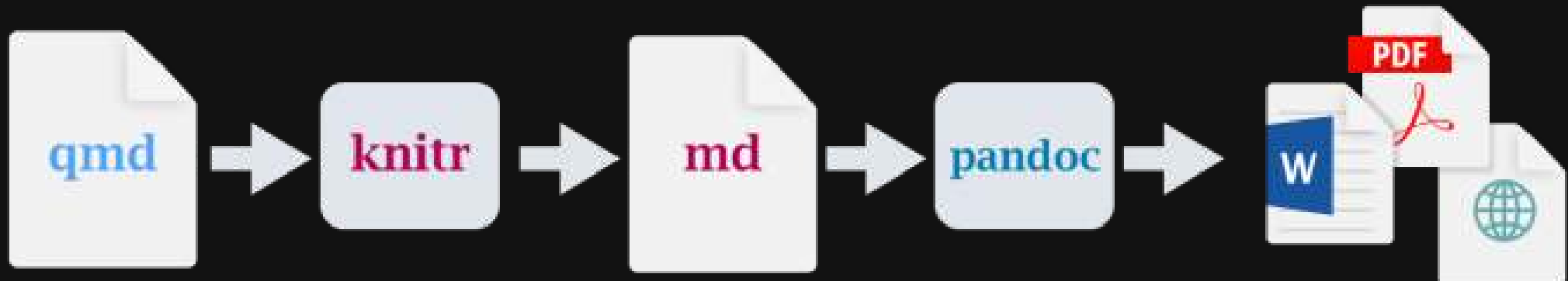
Treat programs as a
"literature" understandable
to **human beings**



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

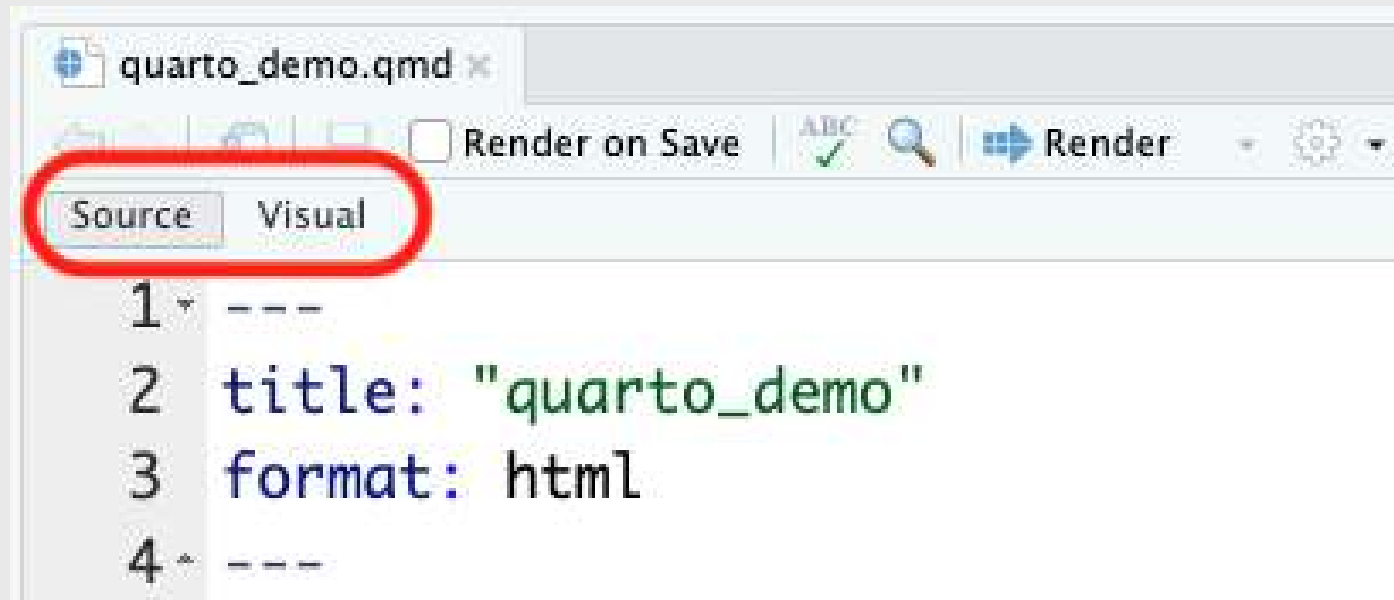
Simple **url link** to another site:

[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}  
#| message: false
#| warning: false

library(tidyverse)
```
```

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`

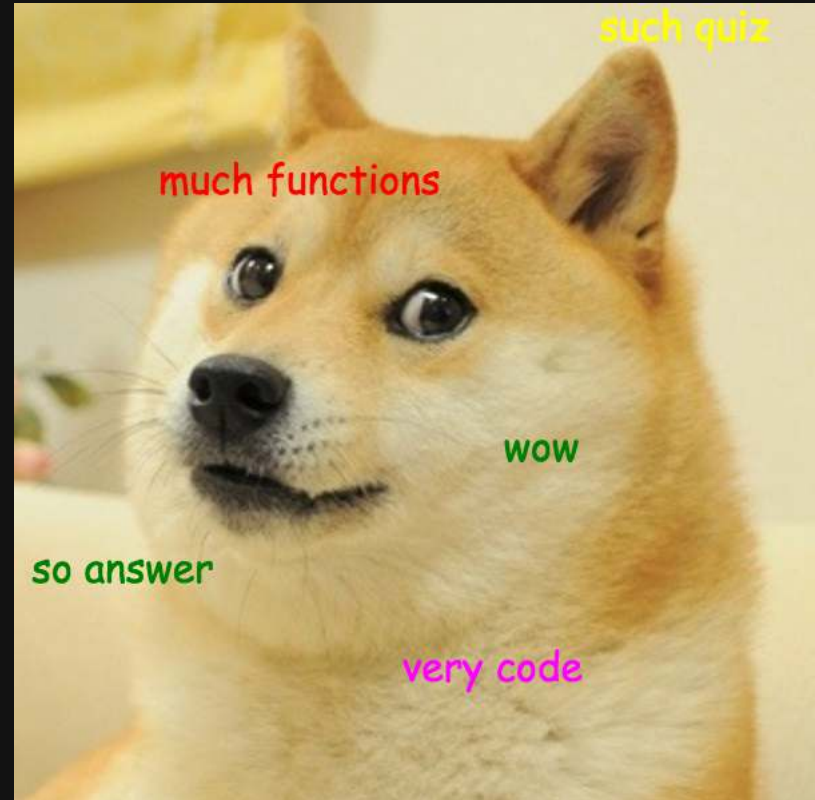
Quiz 1

Download the template from the
#class channel

Make sure you unzip it!

When done, submit your
quiz1.qmd on Blackboard

10:00



Week 3: *Quarto & Plotting*

1. Intro to Quarto

QUIZ 1

2. Intro to ggplot2

3. Project attributes & levels

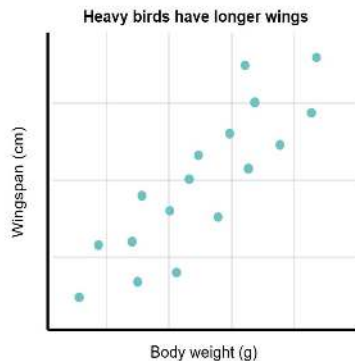
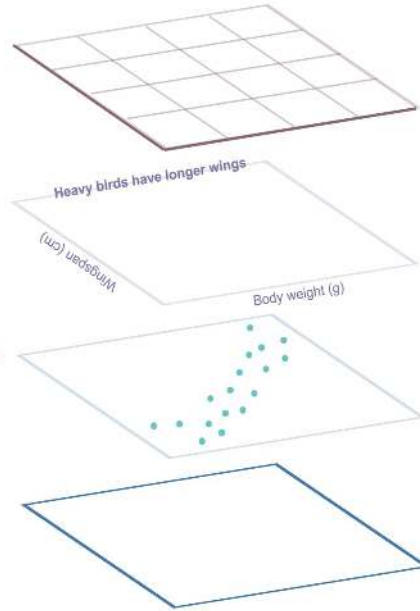
MAKING A GRAPH WITH GGPLOT2

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

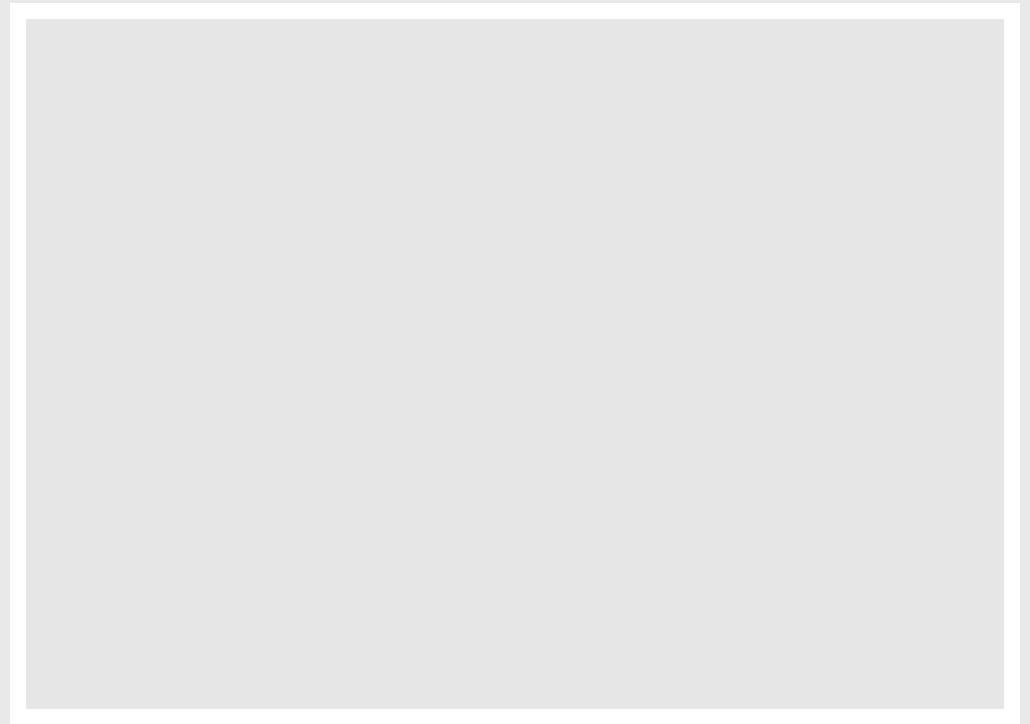
```
head(mpg)
```

```
#> # 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

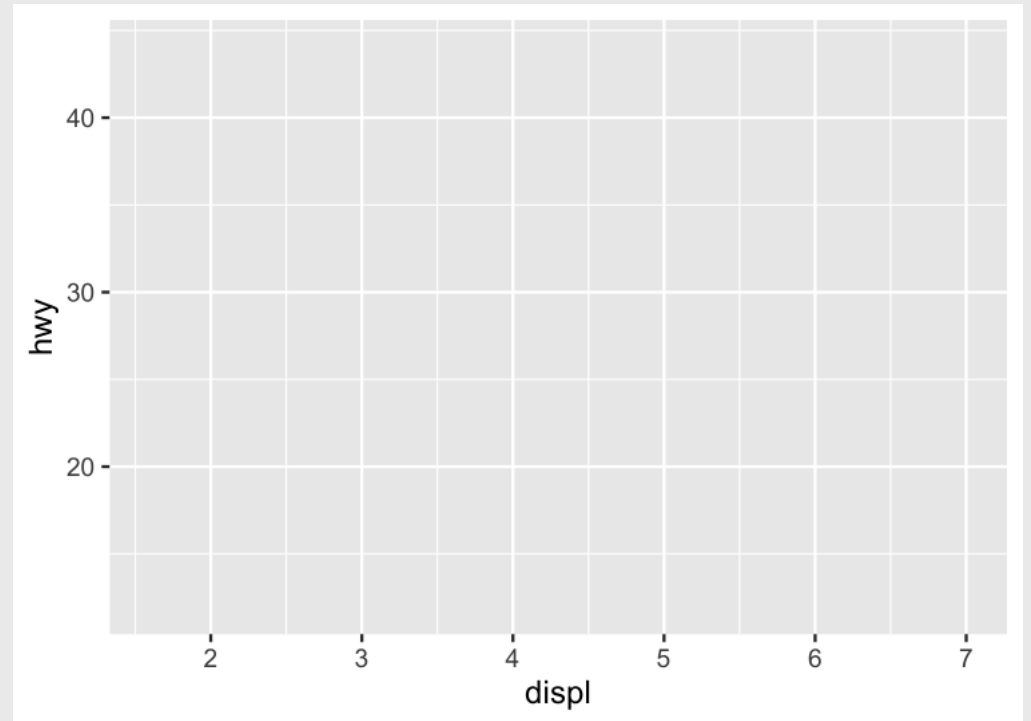
```
mpg %>%  
  ggplot()
```



Layer 2: The aesthetic mapping

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

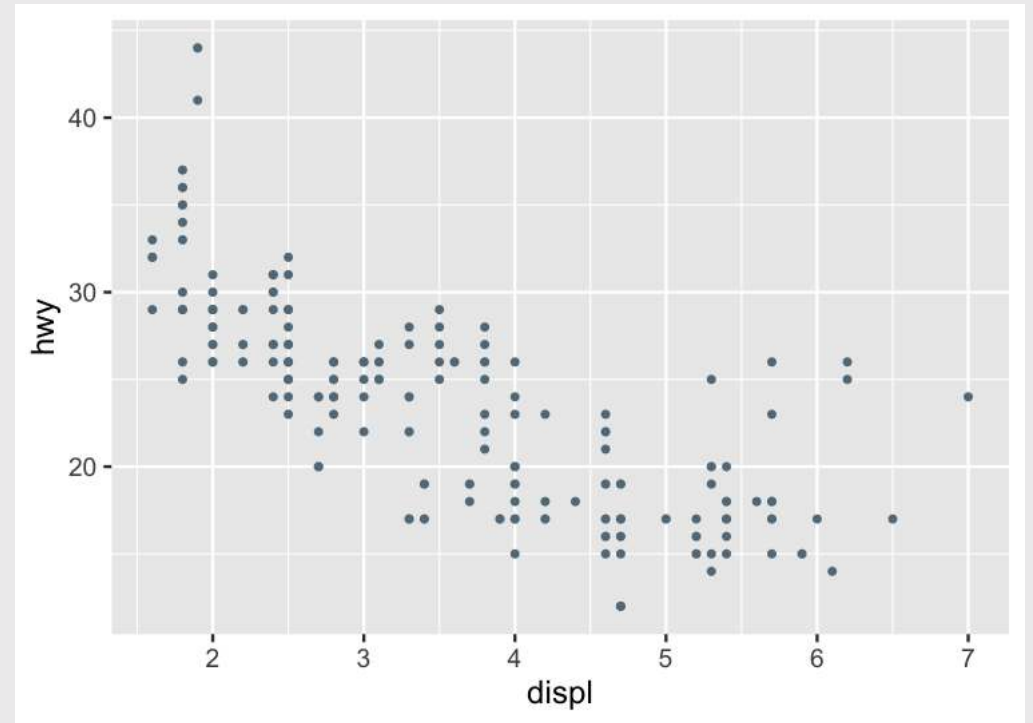
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy))
```



Layer 3: The geometries

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

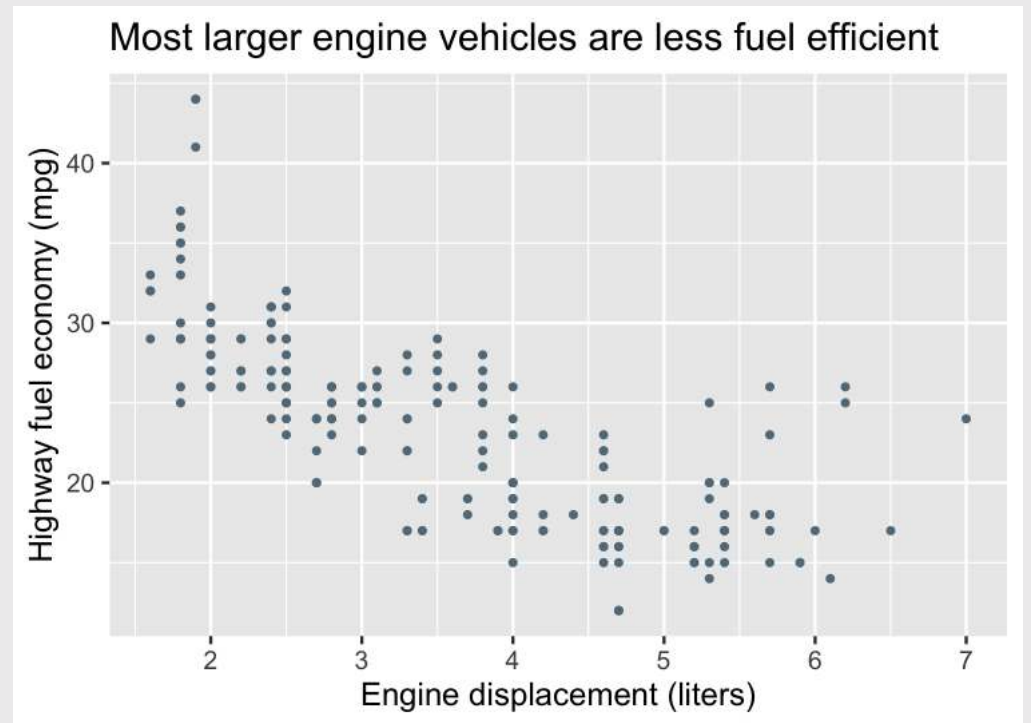
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy)) +  
  geom_point()
```



Layer 4: The annotations / labels

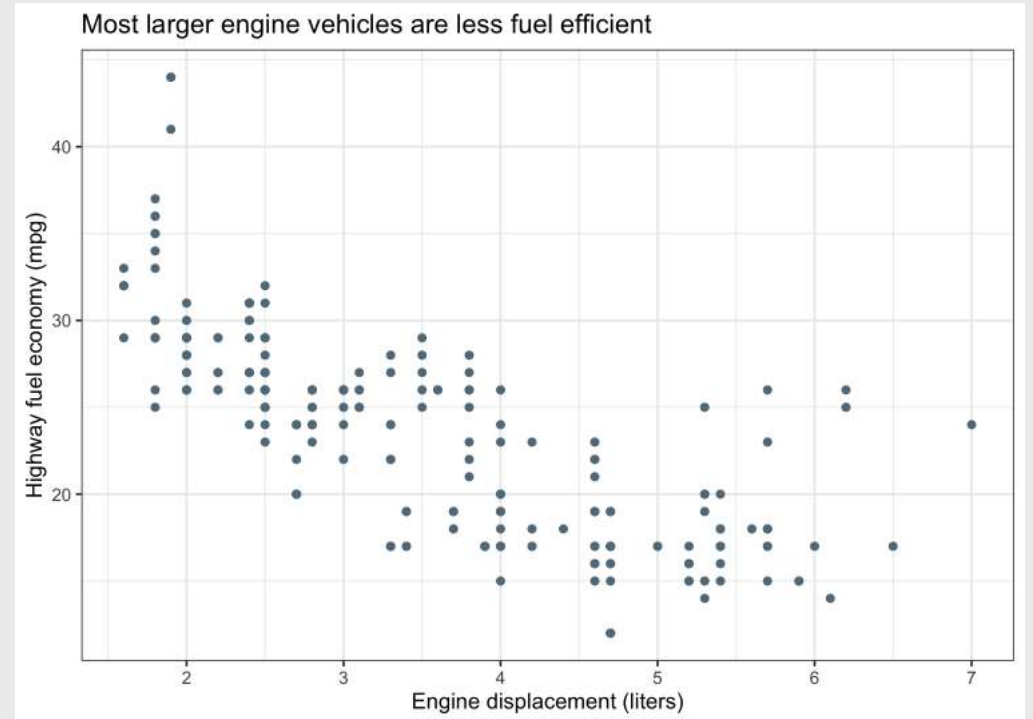
Use `labs()` to modify most labels

```
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

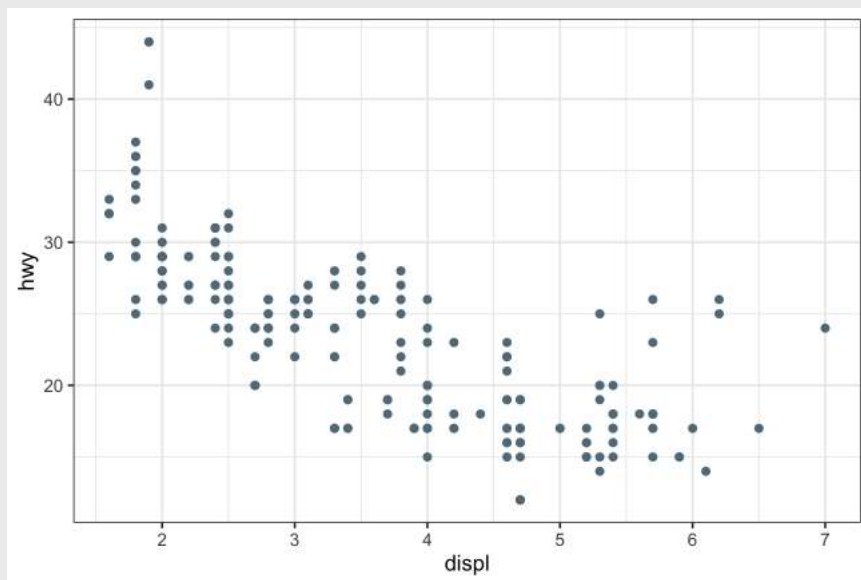
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy)) +  
  geom_point() +  
  labs(  
    x = "Engine displacement (liters)",  
    y = "Highway fuel economy (mpg)",  
    title = "Most larger engine vehicles  
are less fuel efficient"  
  ) +  
  theme_bw()
```



Common themes

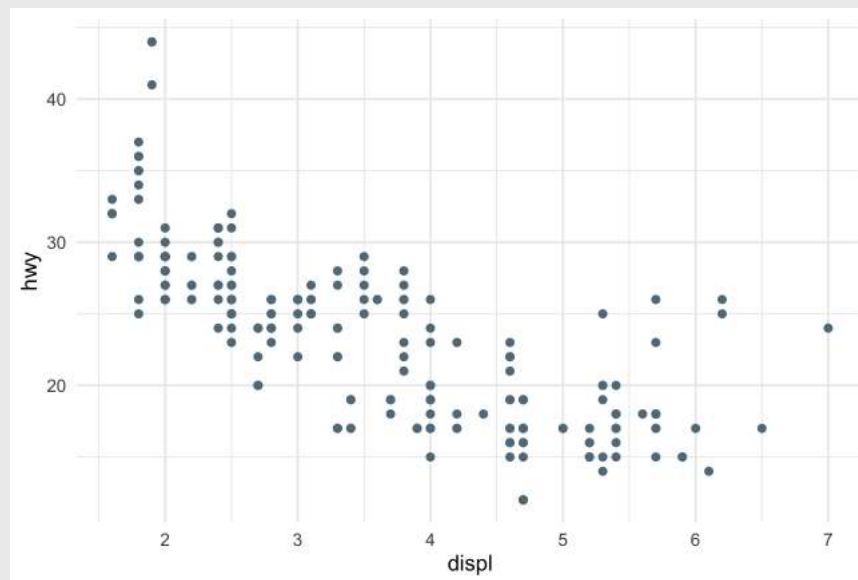
theme_bw()

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



theme_minimal()

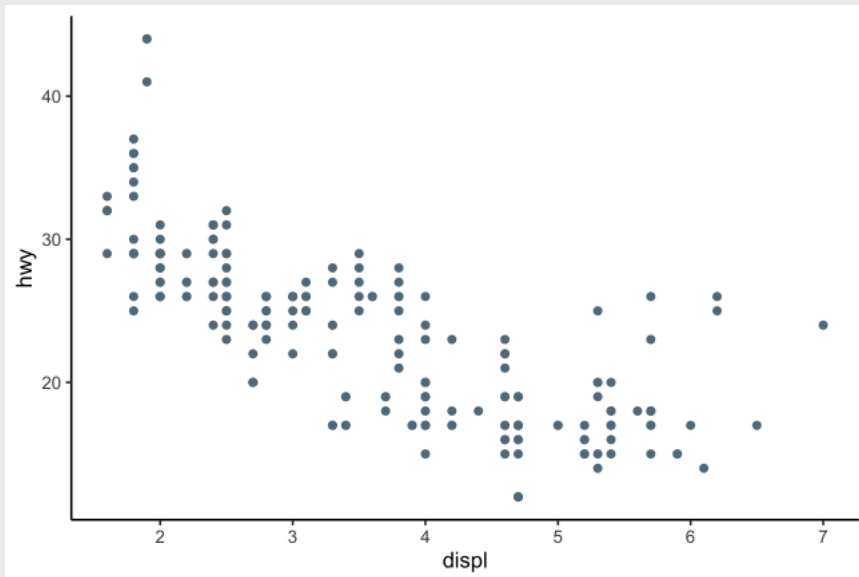
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy)) +  
  geom_point() +  
  theme_minimal()
```



Common themes

theme_classic()

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



theme_void()

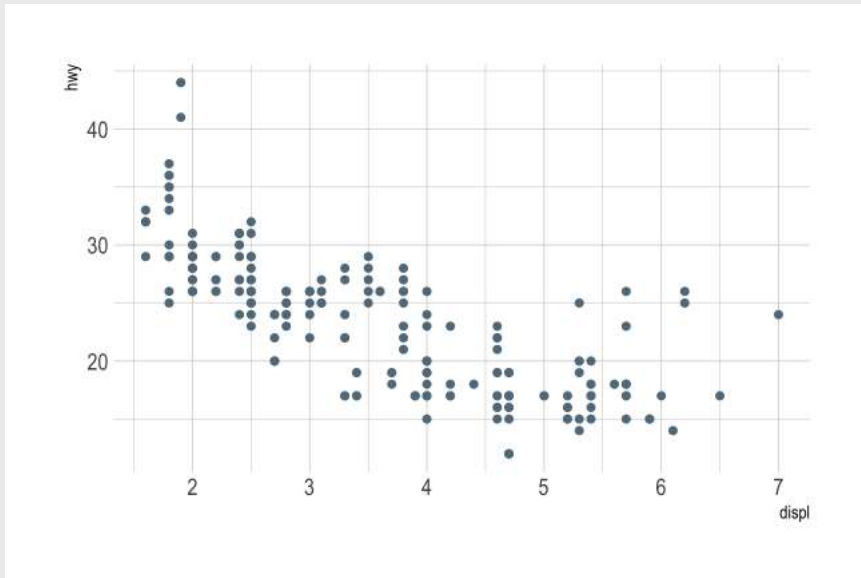
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy)) +  
  geom_point() +  
  theme_void()
```



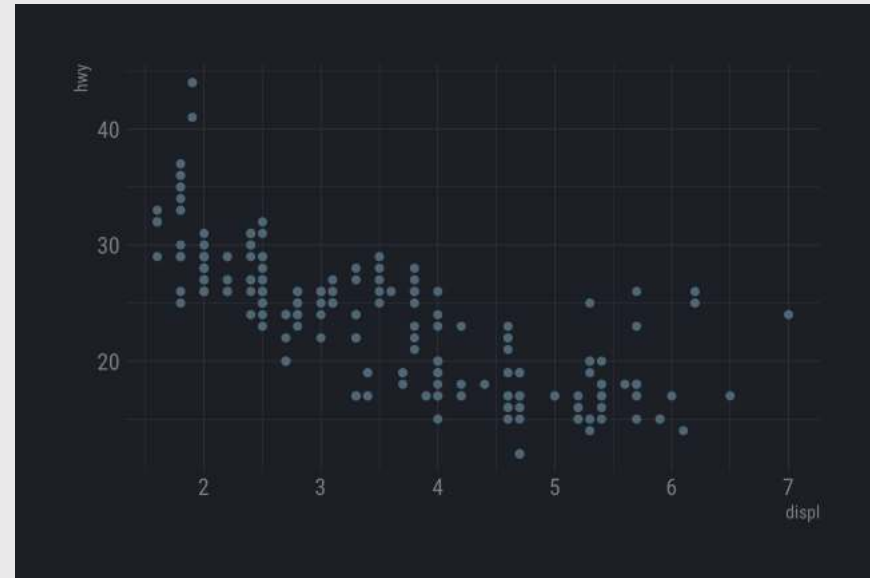
Other themes: [hrbrthemes](#)

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

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



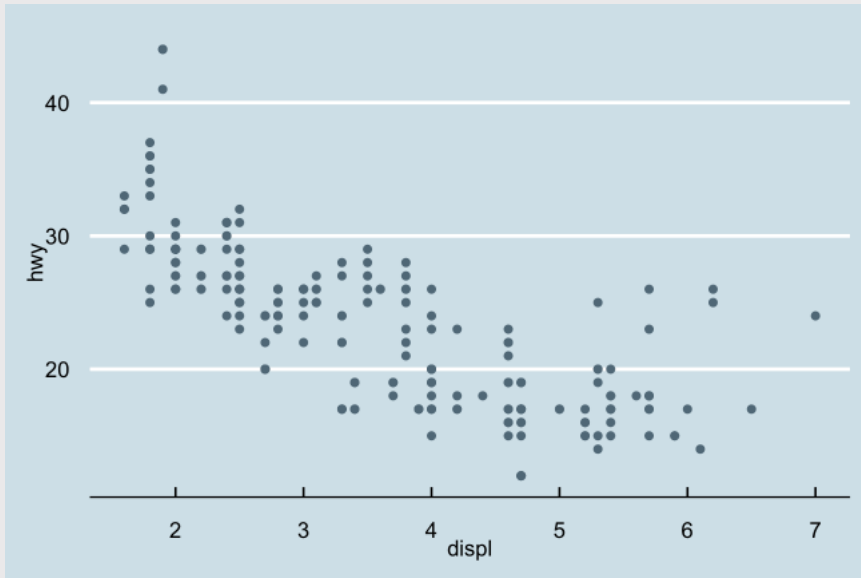
```
mpg %>%  
  ggplot(aes(x = displ, y = hwy)) +  
  geom_point() +  
  hrbrthemes::theme_ft_rc()
```



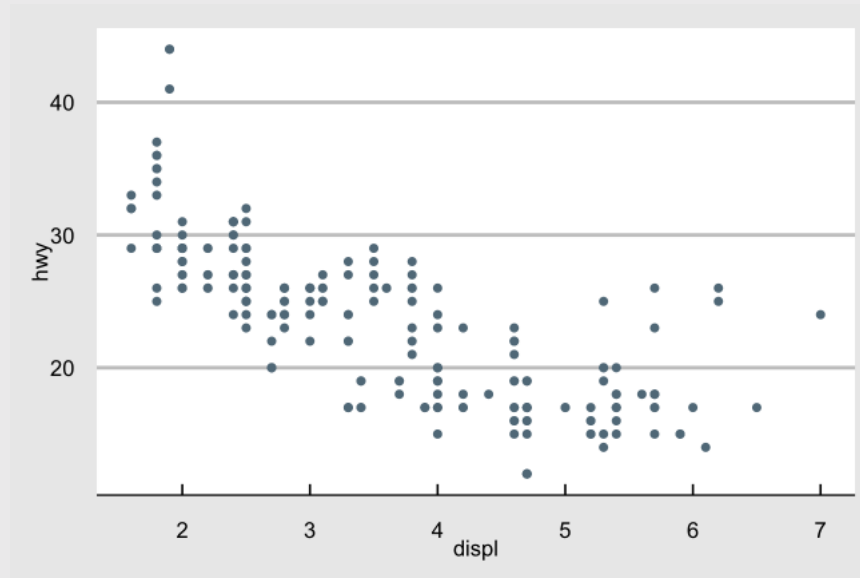
Other themes: `ggthemes`

```
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

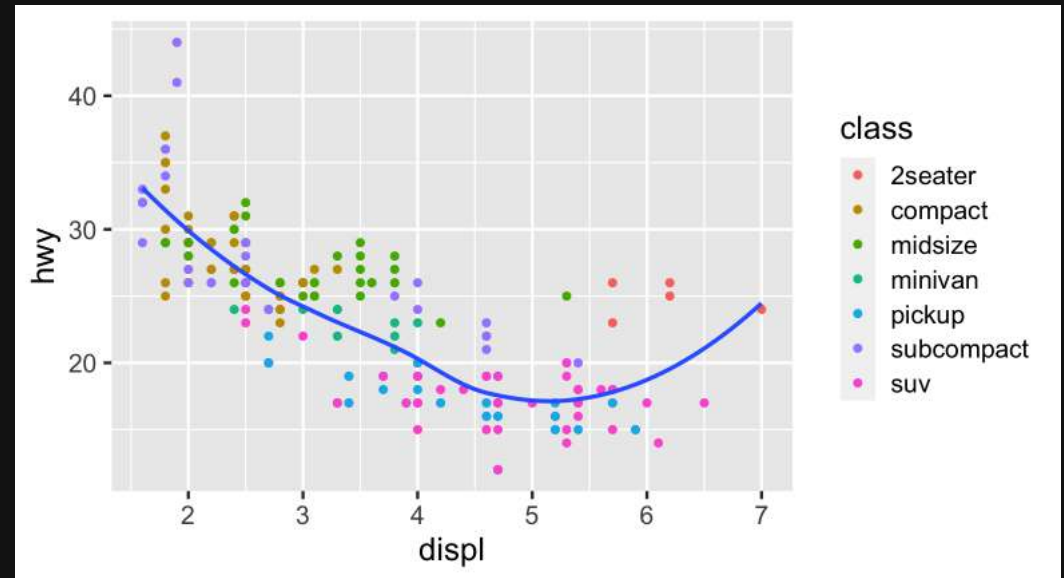
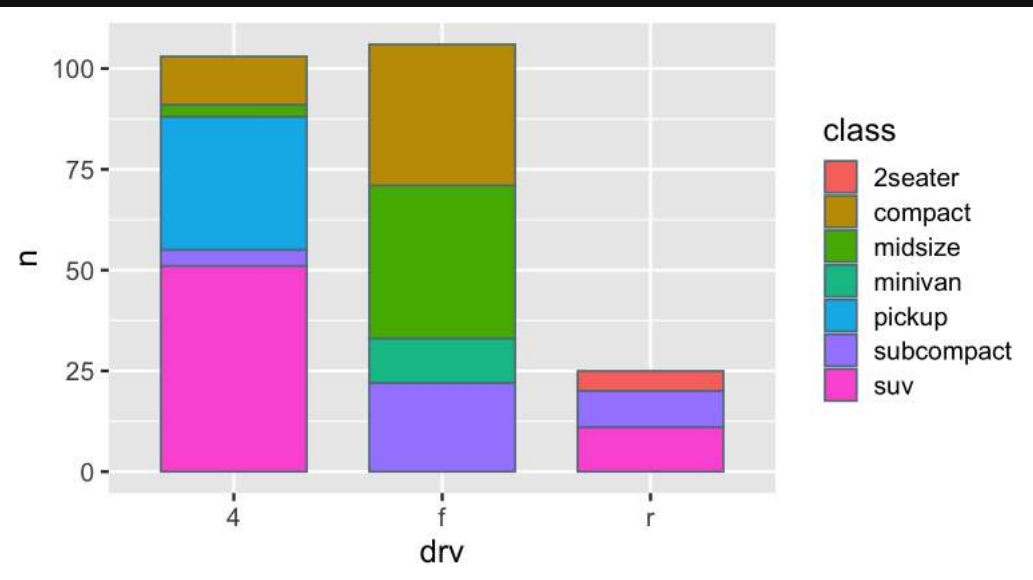
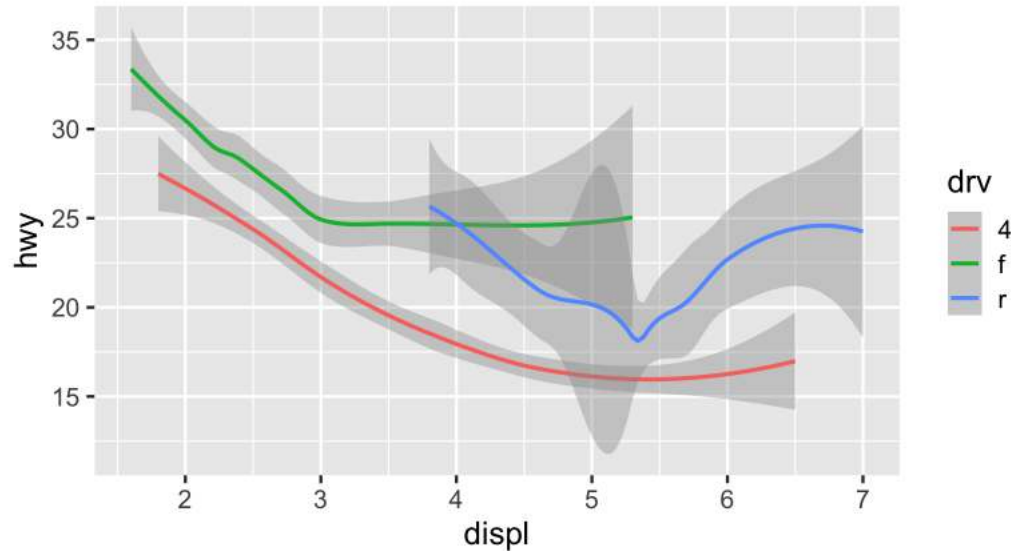
Open `ggplot2.qmd`

15:00

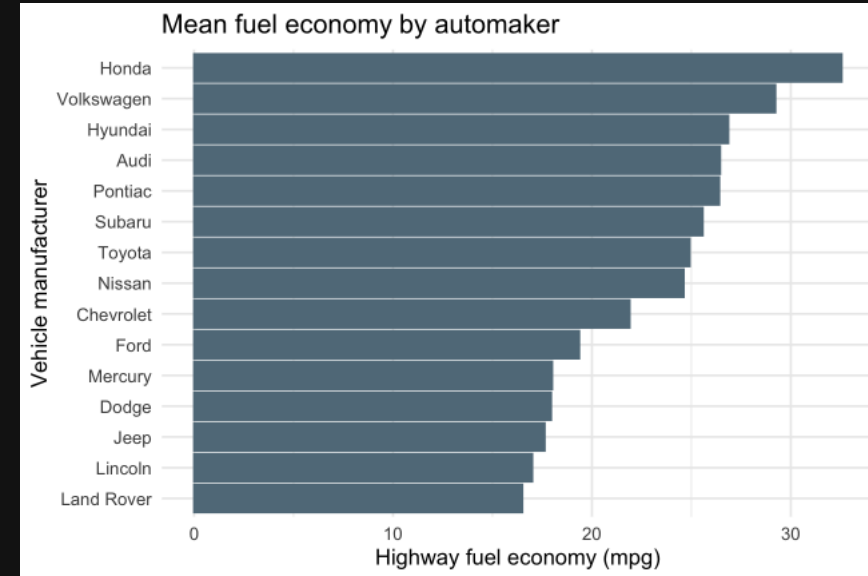
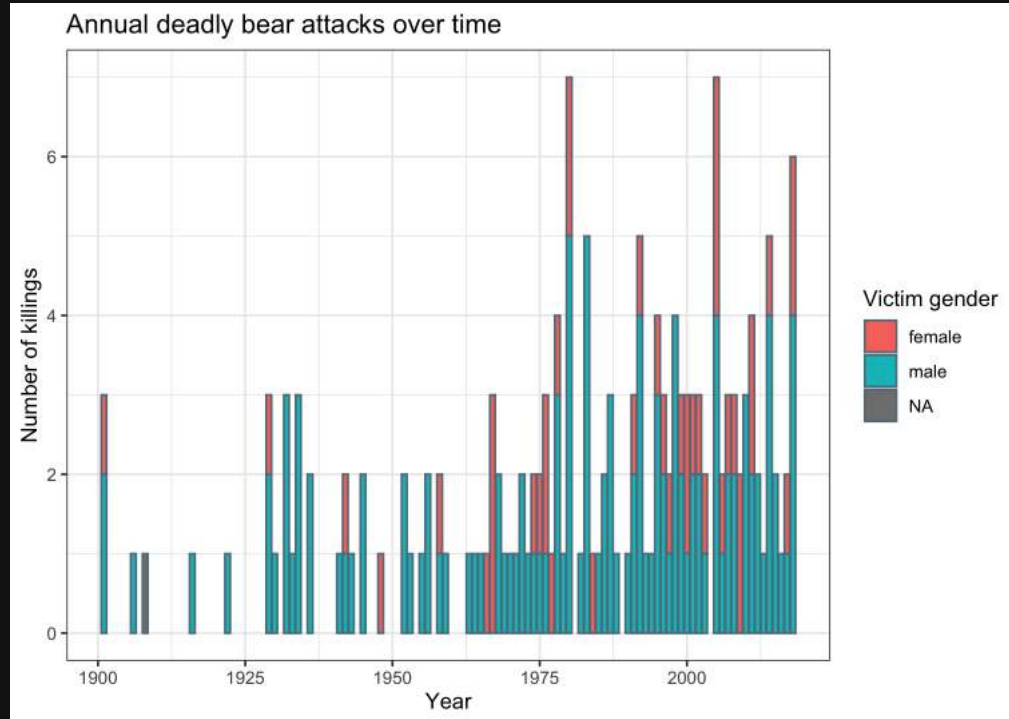
Your turn

Open `practice.qmd`

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



Extra practice



Week 3: *Quarto & Plotting*

1. Intro to Quarto

QUIZ 1

2. Intro to ggplot2

3. Project attributes & levels

Model Relationships Table (example)

| | | <i>Features</i> | | | <i>Competitors</i> | |
|---------------------------|--------------|-----------------|----------|--------|--------------------|----------------------|
| | | Range | Units | Demand | Aims Solar Panel | SUAOKI Solar Charger |
| Product Attributes | 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^3 | + | 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