Week 3: *Quarto & Plotting*

🏛 EMSE 6035: Marketing Analytics for Design Decisions

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📅 September 13, 2023

Week 3: *Quarto & Plotting*

1. Intro to Quarto

QUIZ 1

2. Intro to ggplot2

3. Project attributes & levels

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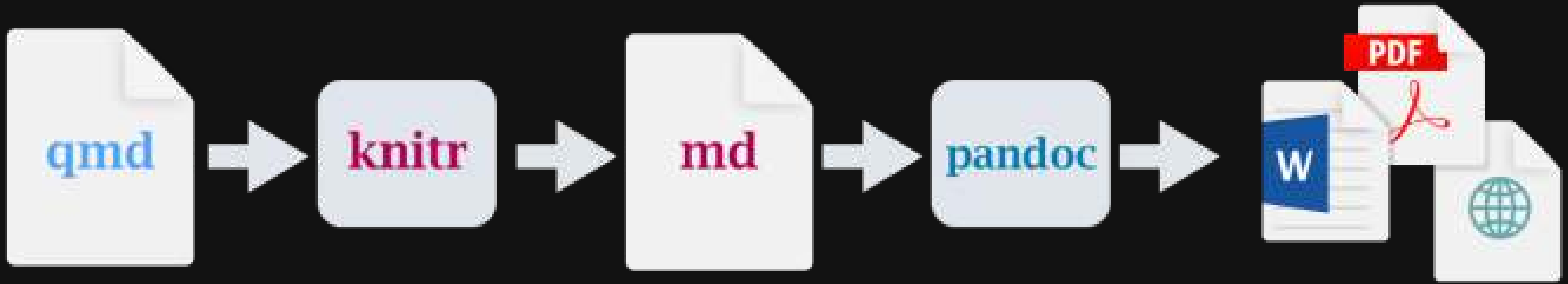
"Literate programming"

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
---
```

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

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

Microsoft Word

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

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

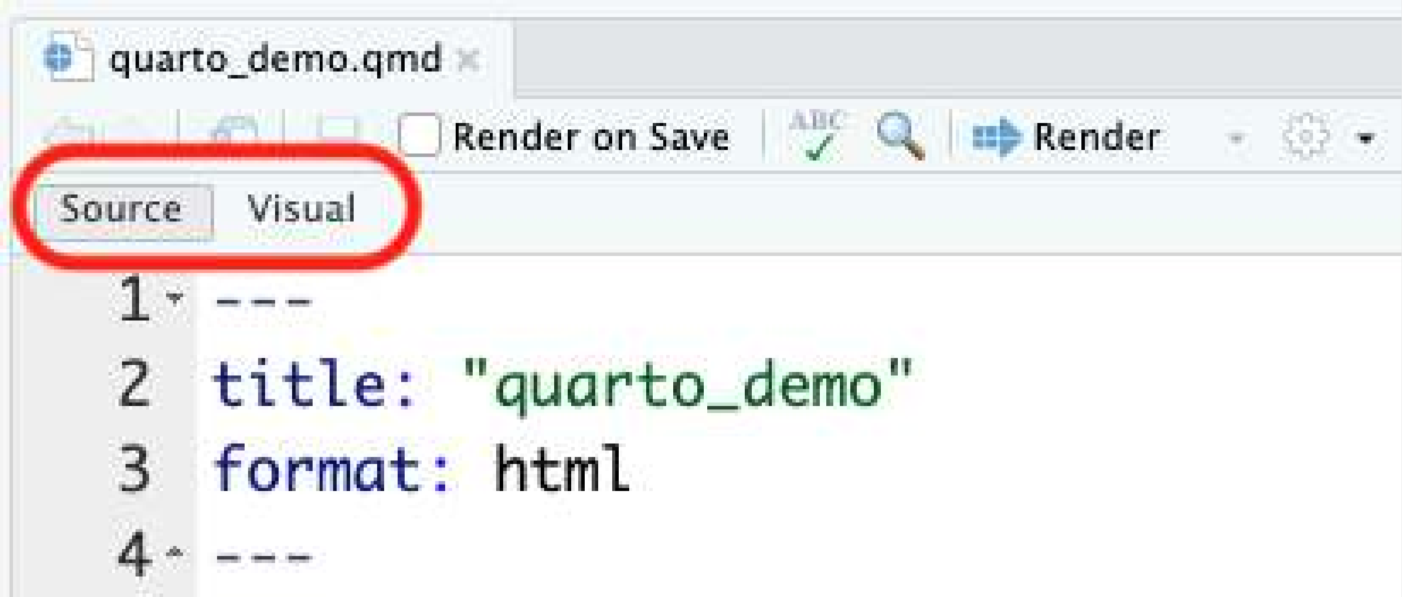
Simple **url link** to another site:

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

Download R

Don't want to use Markdown?

Use Visual Mode!



```
---
title: "quarto_demo"
format: html
---
```

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:

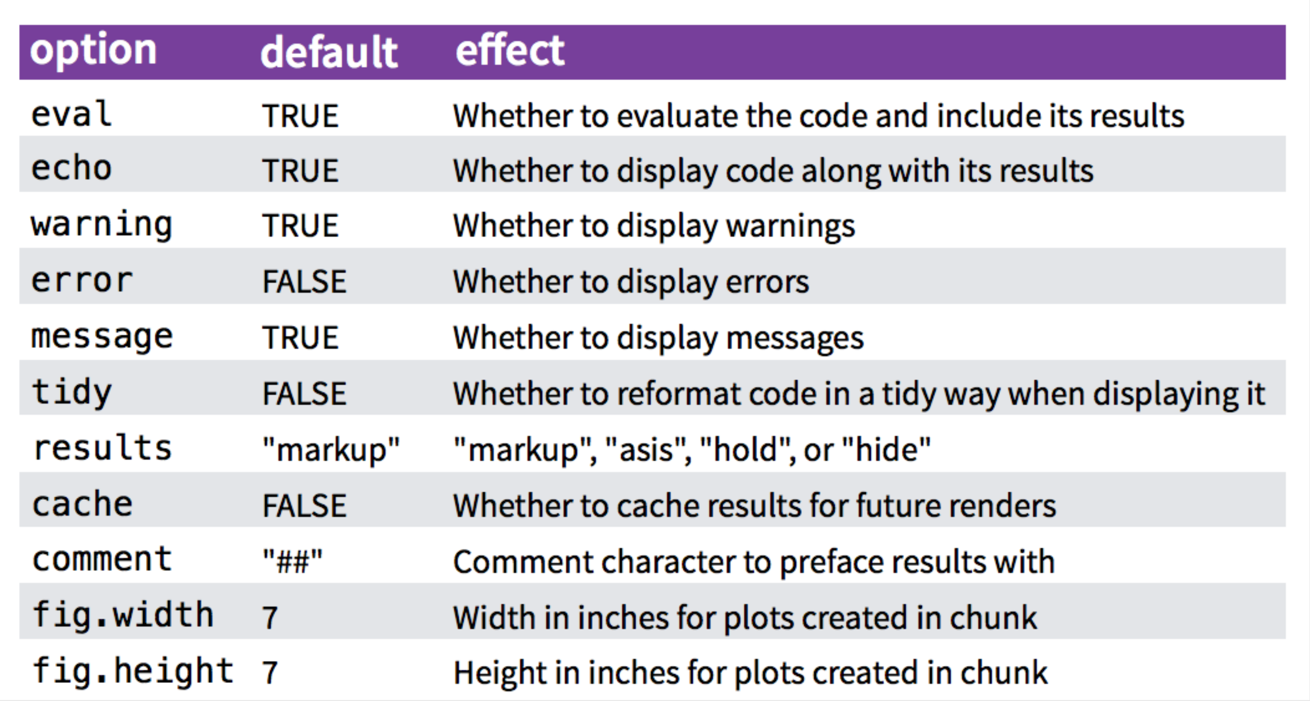
```
library(palmerpenguins)

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`

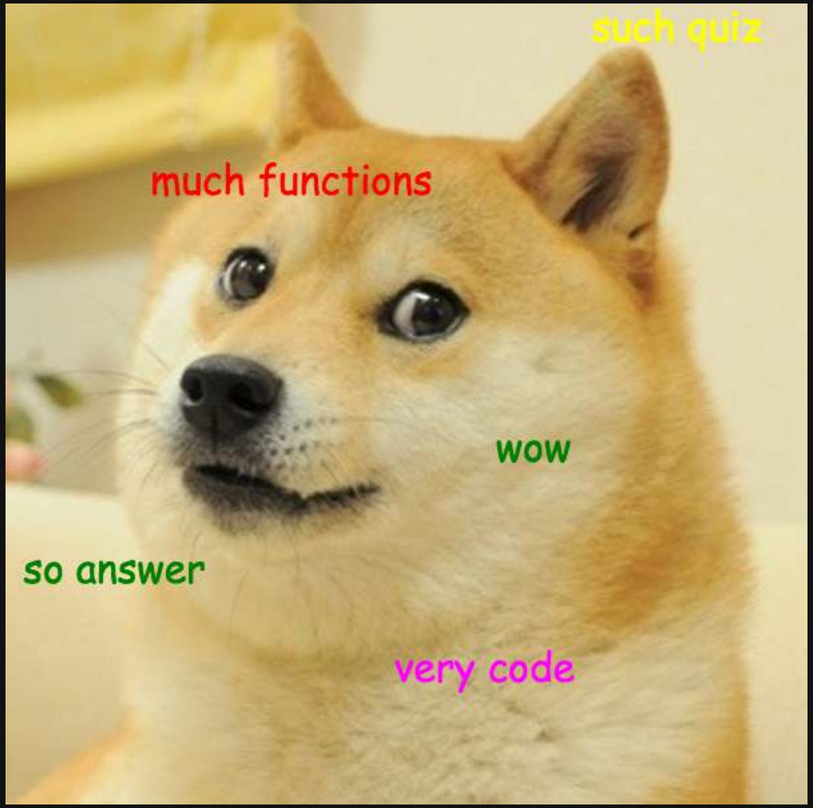
Quiz 1

Download the template from the #class channel

Make sure you unzip it!

When done, submit your `quiz1.qmd` on Blackboard

10:00



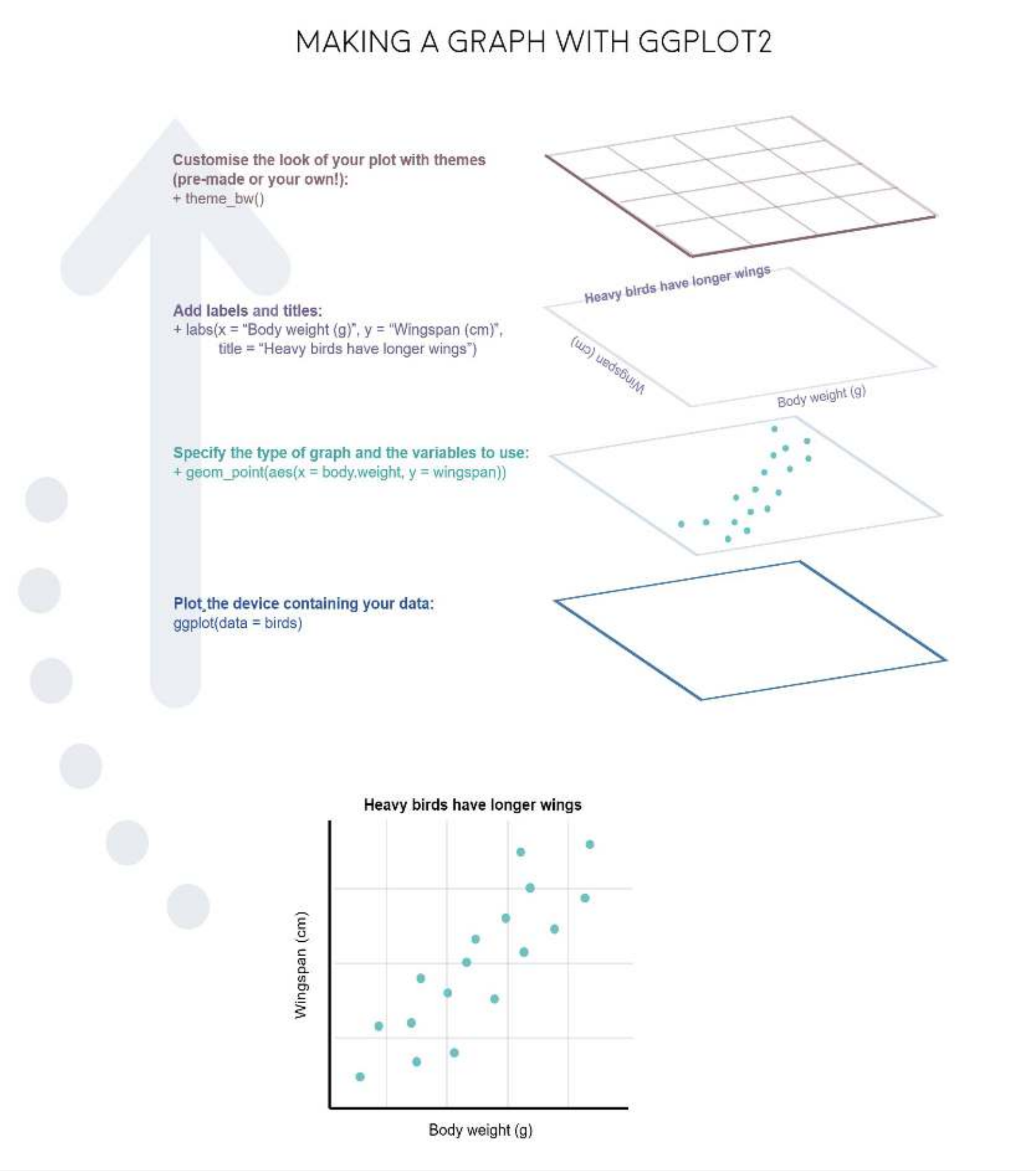
Week 3: *Quarto & Plotting*

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

"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

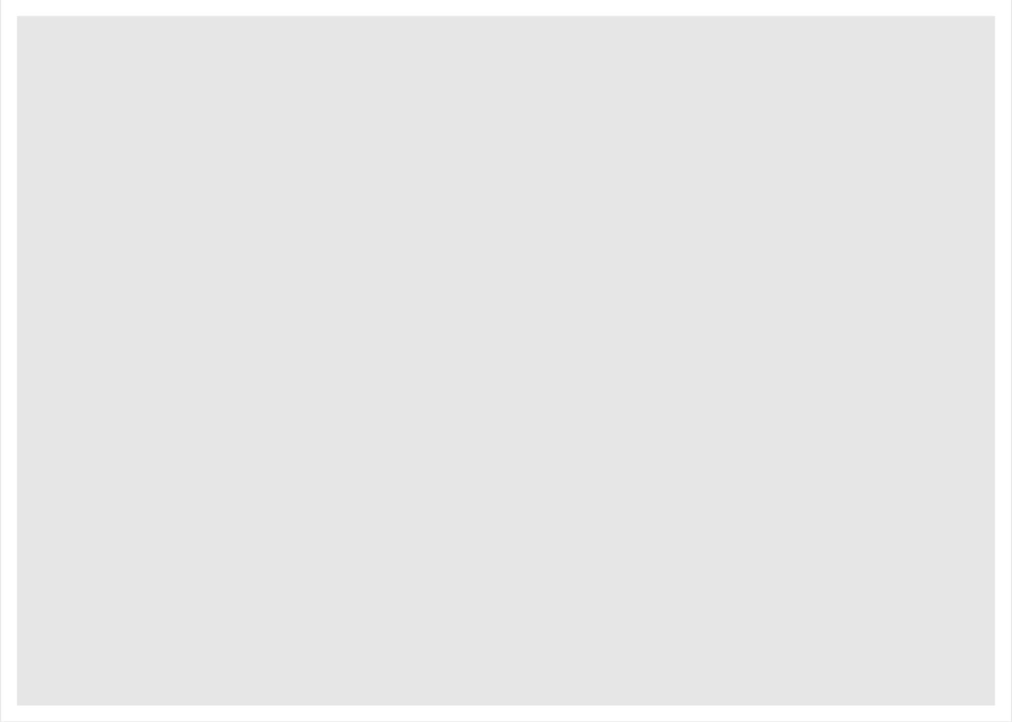
```r
head(mpg)
```

```
#> # 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

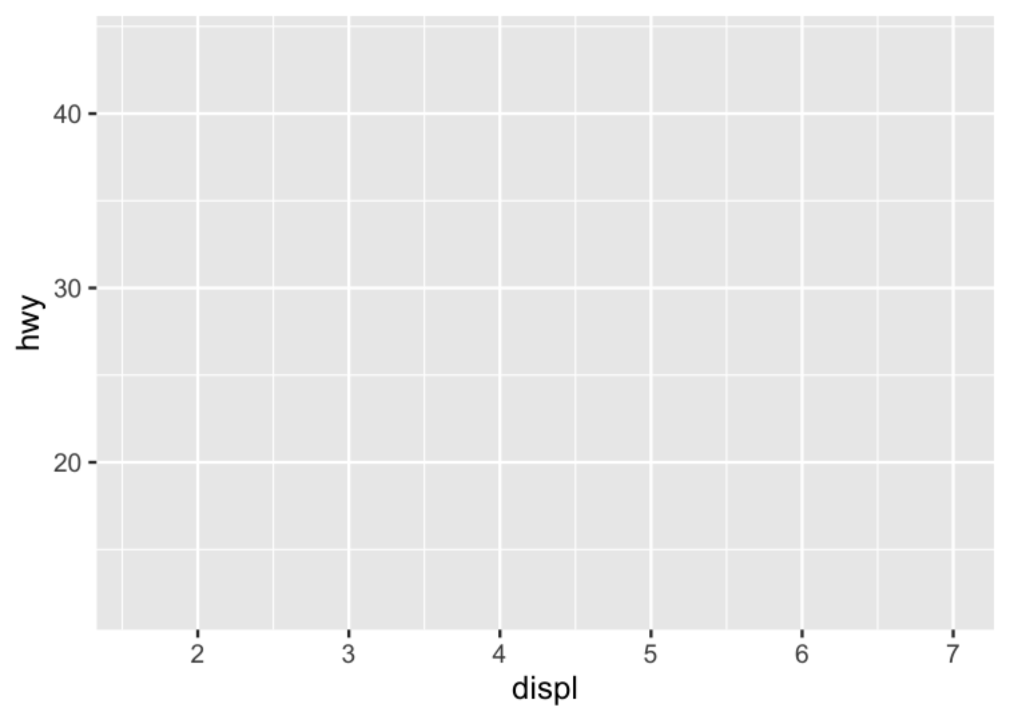
```
mpg %>%
  ggplot()
```



Layer 2: The aesthetic mapping

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

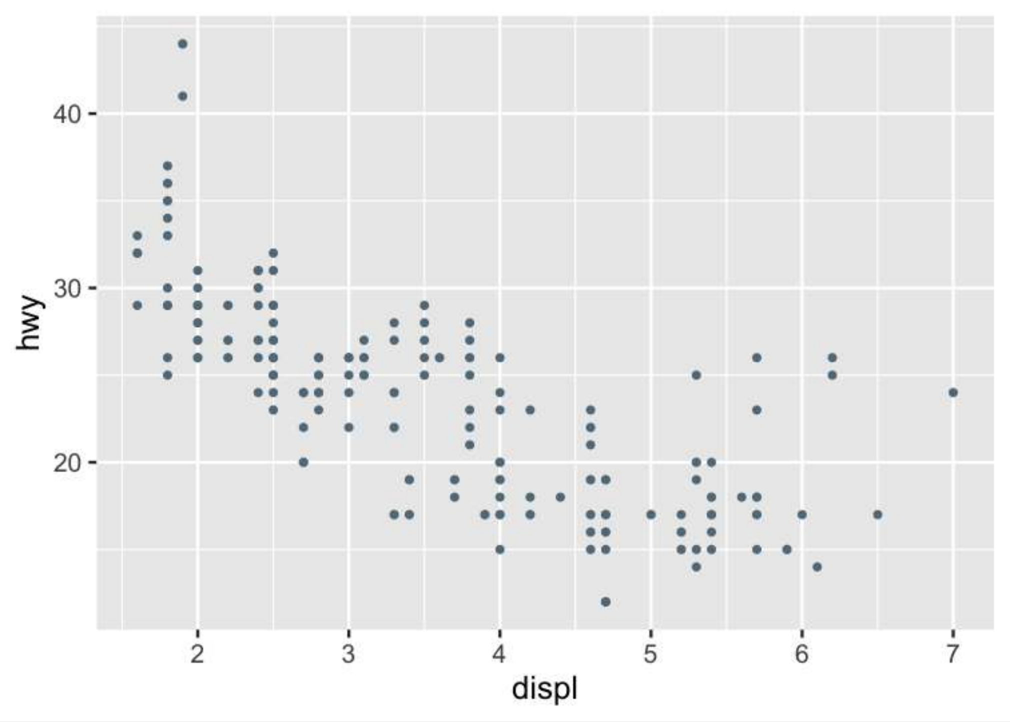
```
mpg %>%
  ggplot(aes(x = displ, y = hwy))
```



Layer 3: The geometries

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

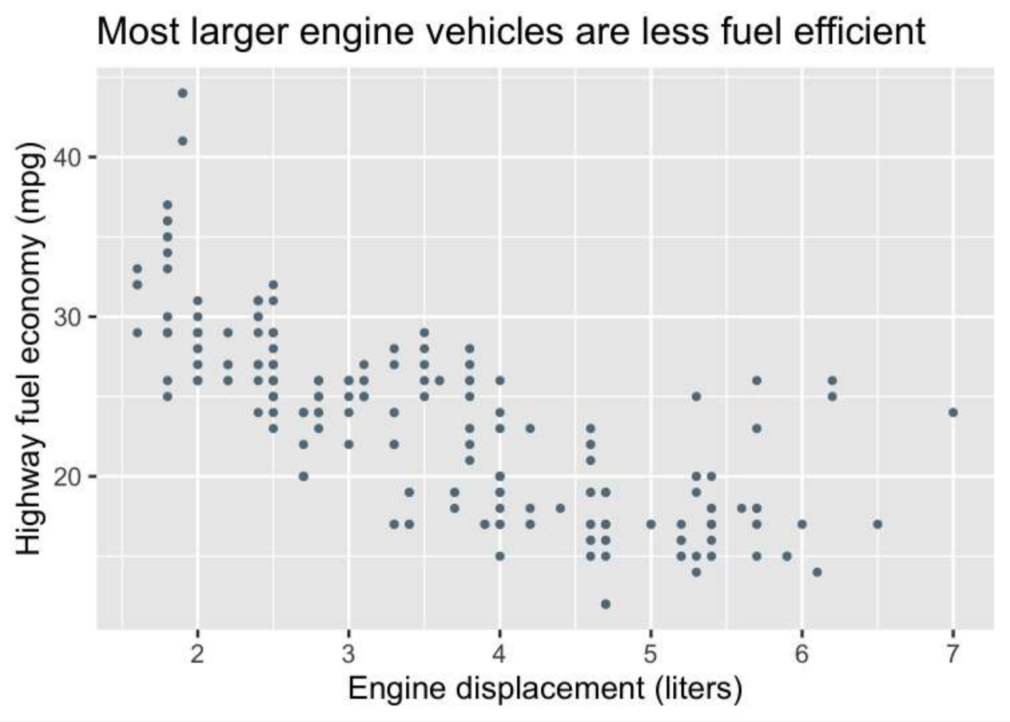
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point()
```



Layer 4: The annotations / labels

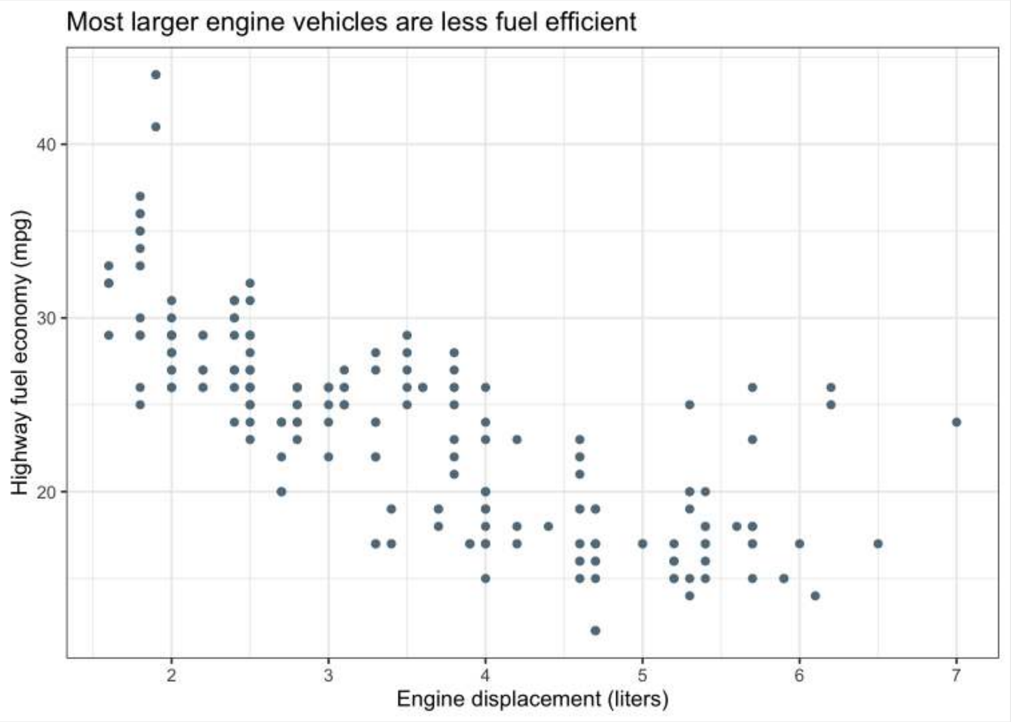
Use `labs()` to modify most labels

```
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

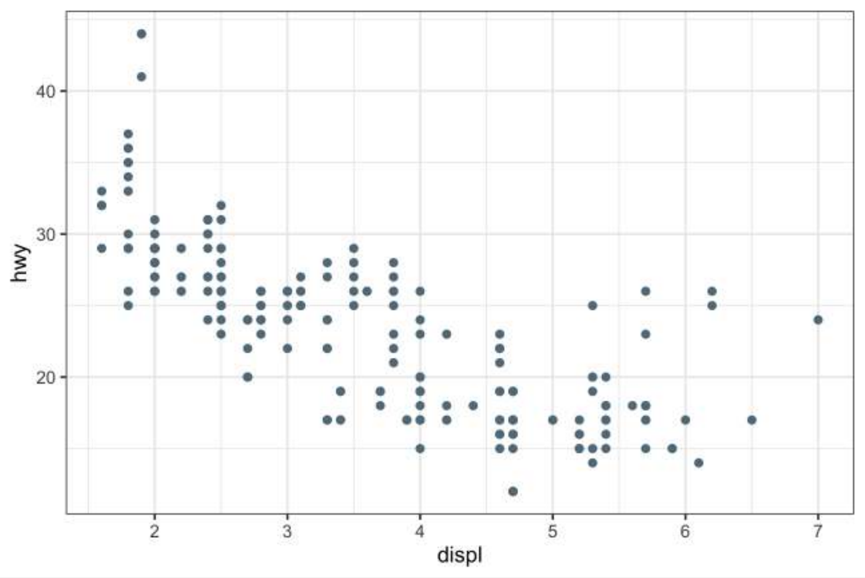
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  labs(
    x = "Engine displacement (liters)",
    y = "Highway fuel economy (mpg)",
    title = "Most larger engine vehicles
are less fuel efficient"
  ) +
  theme_bw()
```



Common themes

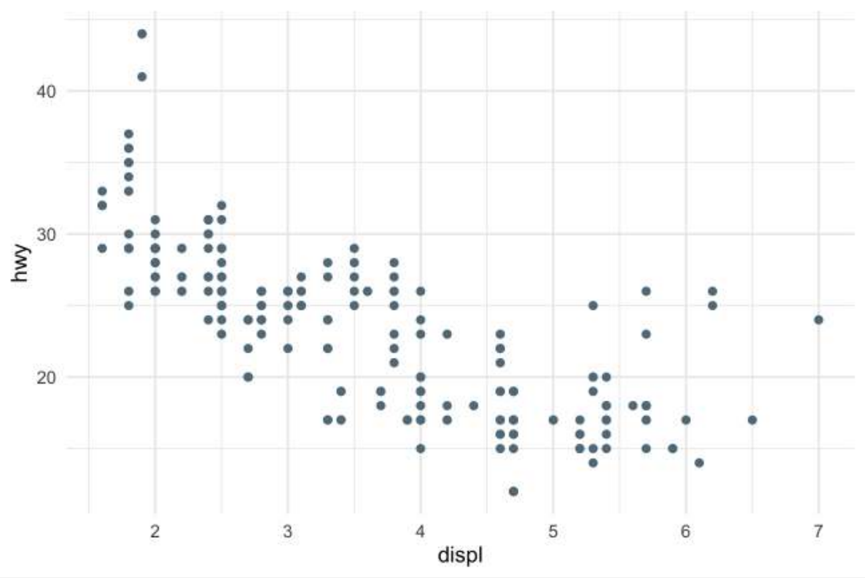
theme_bw()

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



theme_minimal()

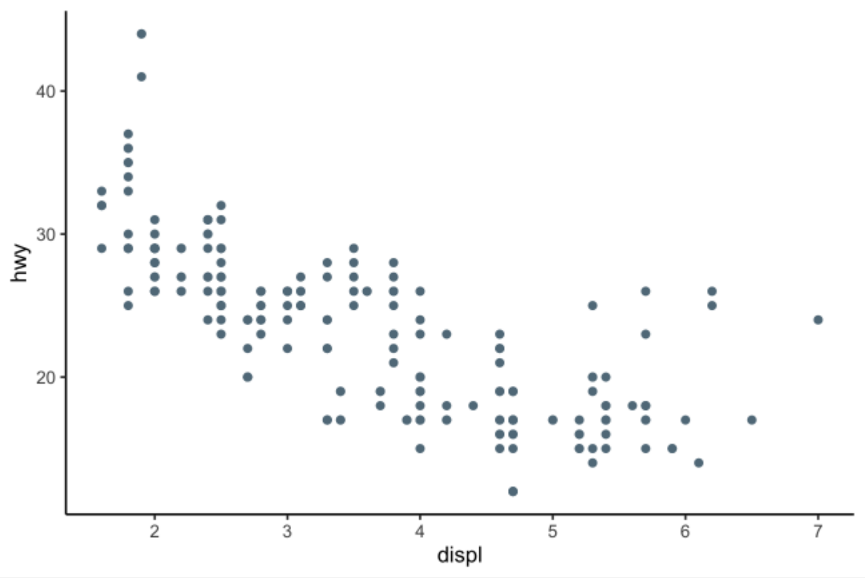
```r
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  theme_minimal()
```



Common themes

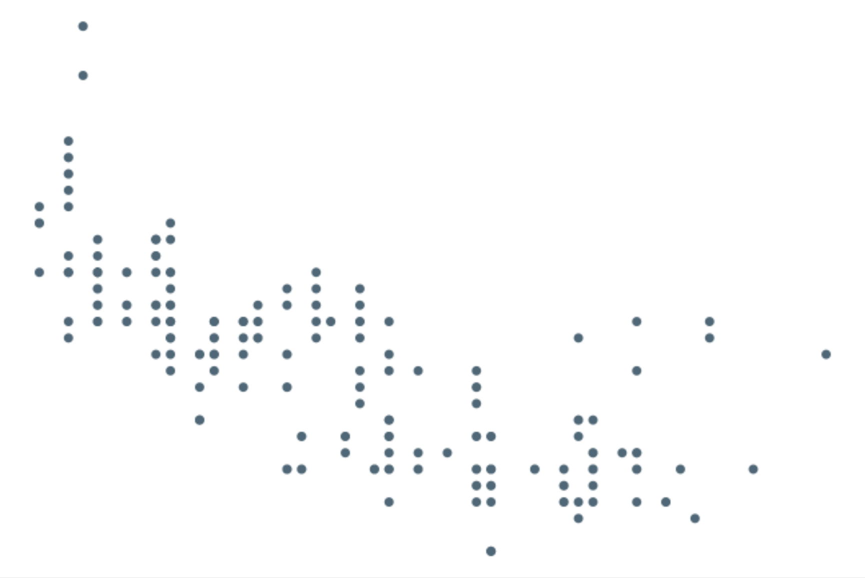
`theme_classic()`

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



`theme_void()`

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

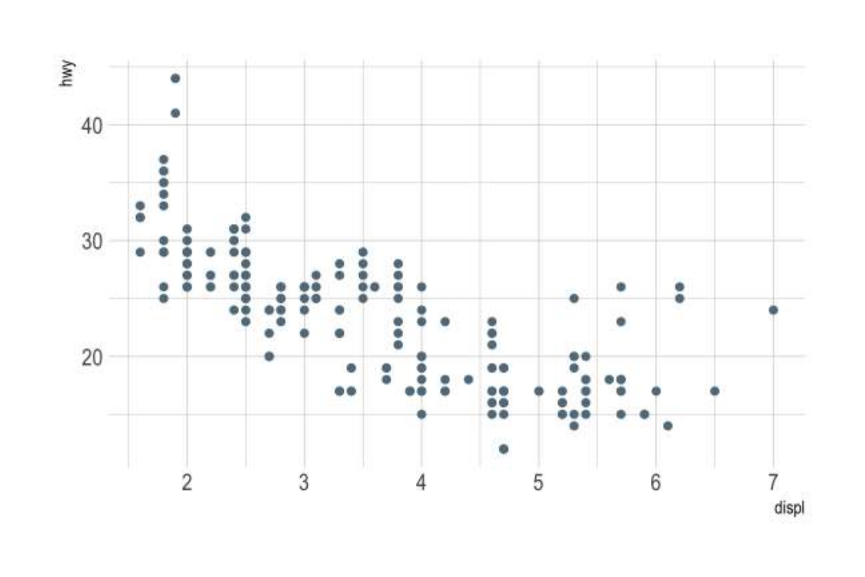


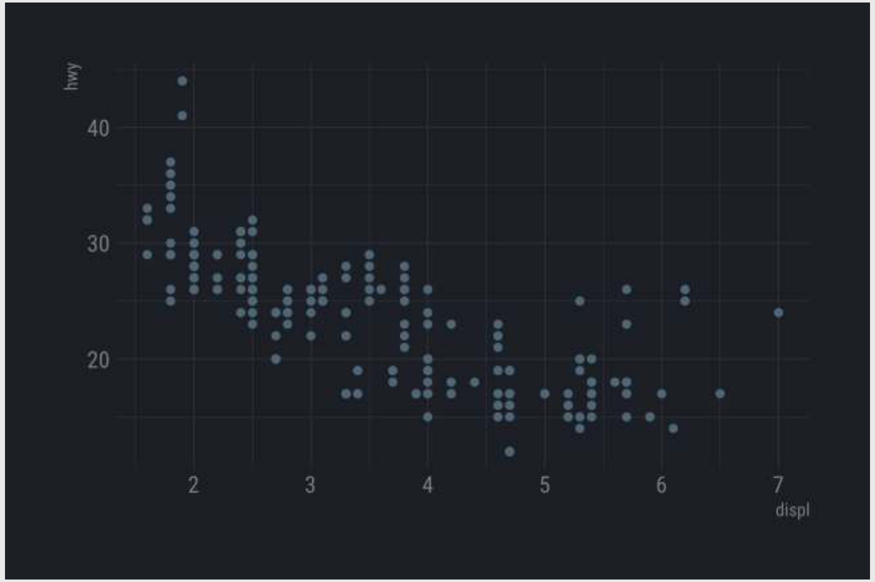
Other themes: hrbrthemes

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

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

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



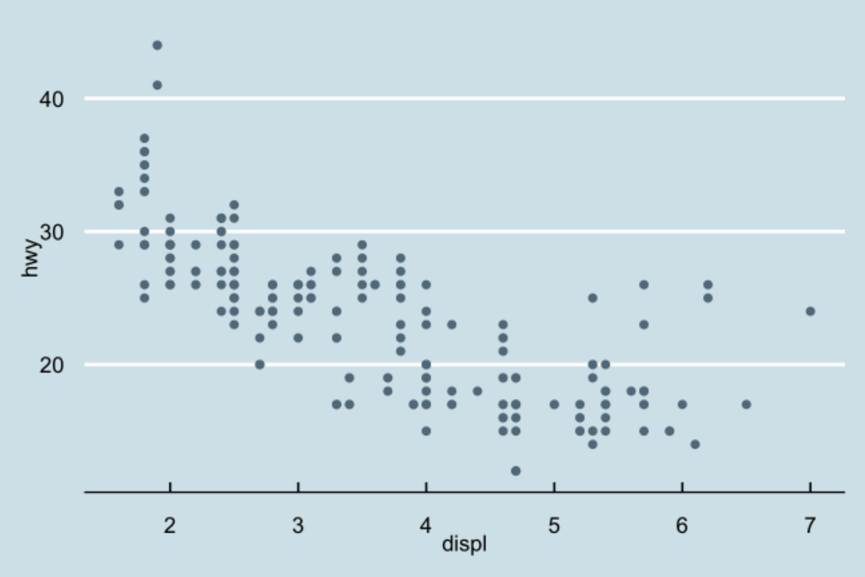


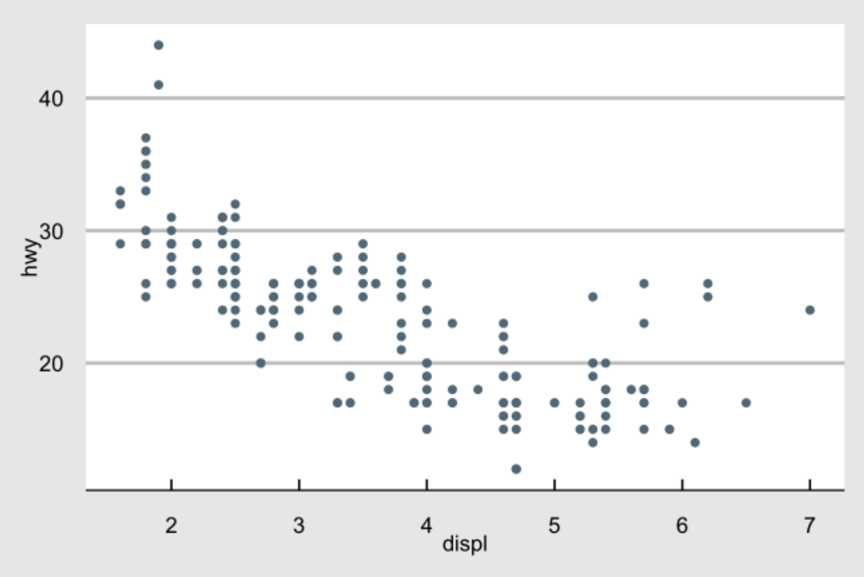
Other themes: ggthemes

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

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

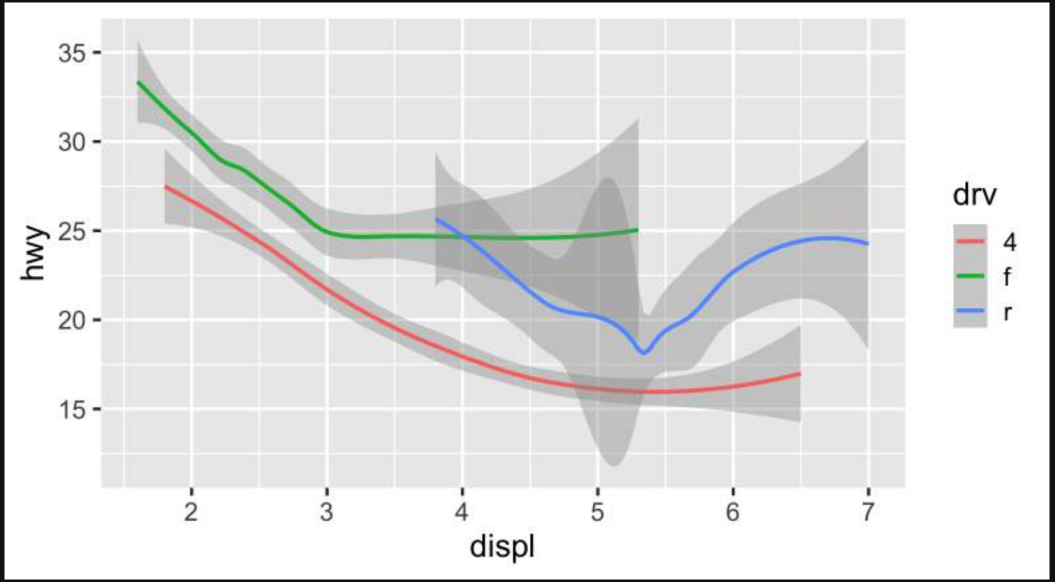
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  ggthemes::theme_economist_white()
```

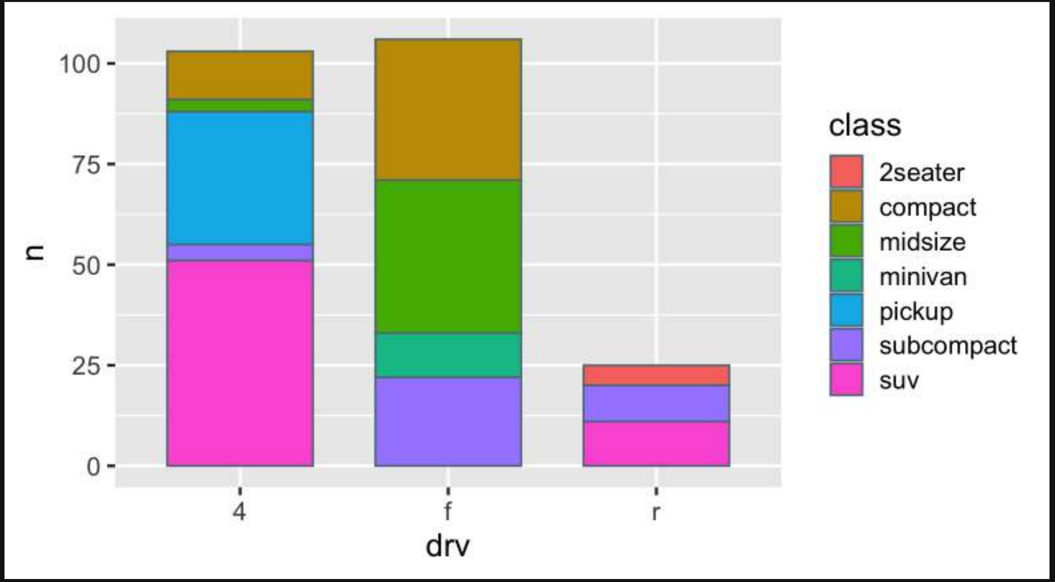




More practice

Open `ggplot2.qmd`



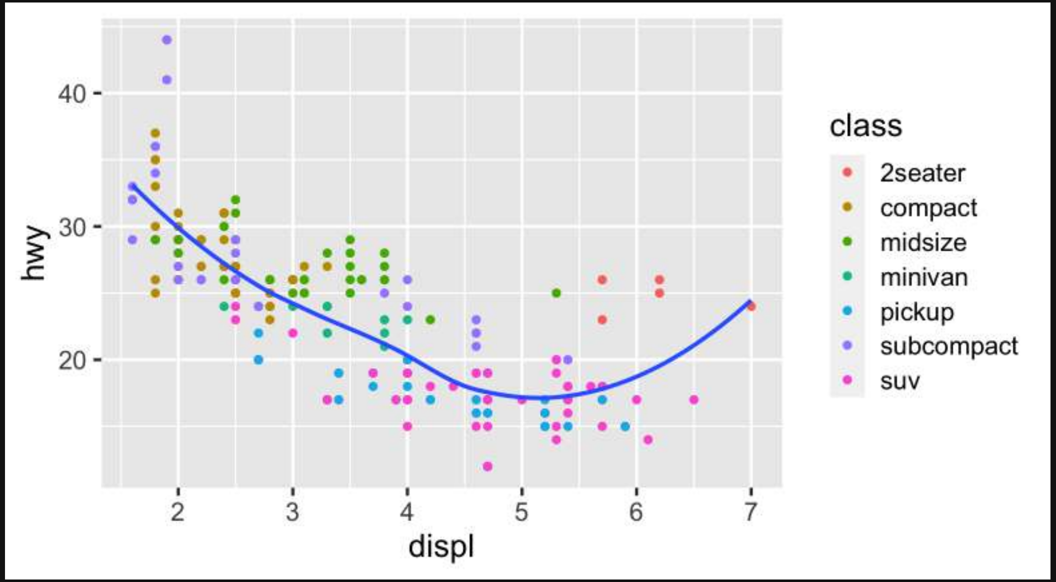


15:00

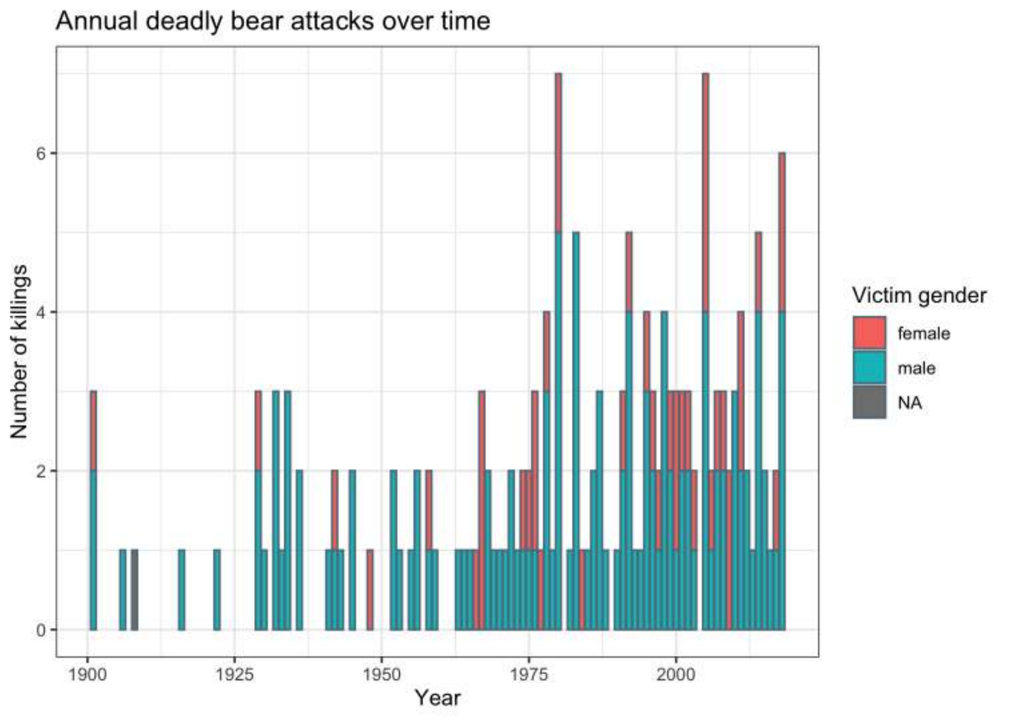
Your turn

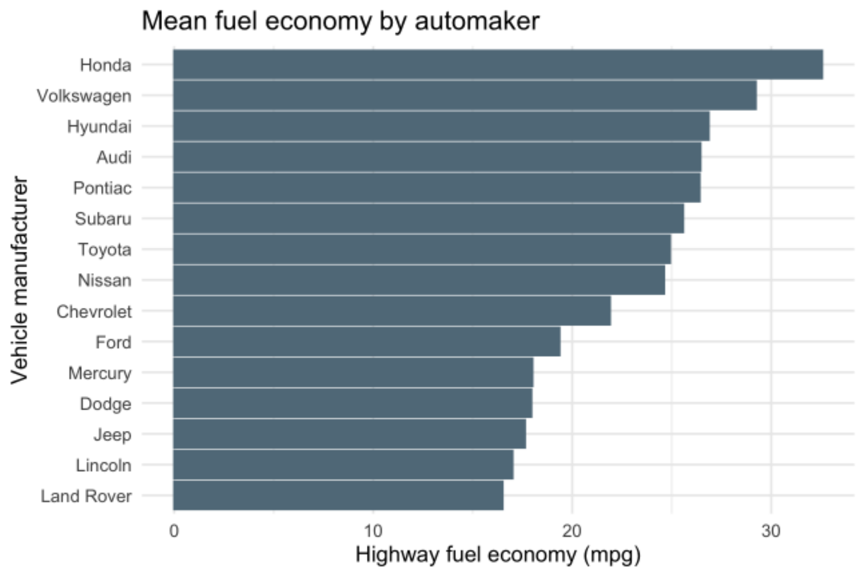
Open `practice.qmd`

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



Extra practice





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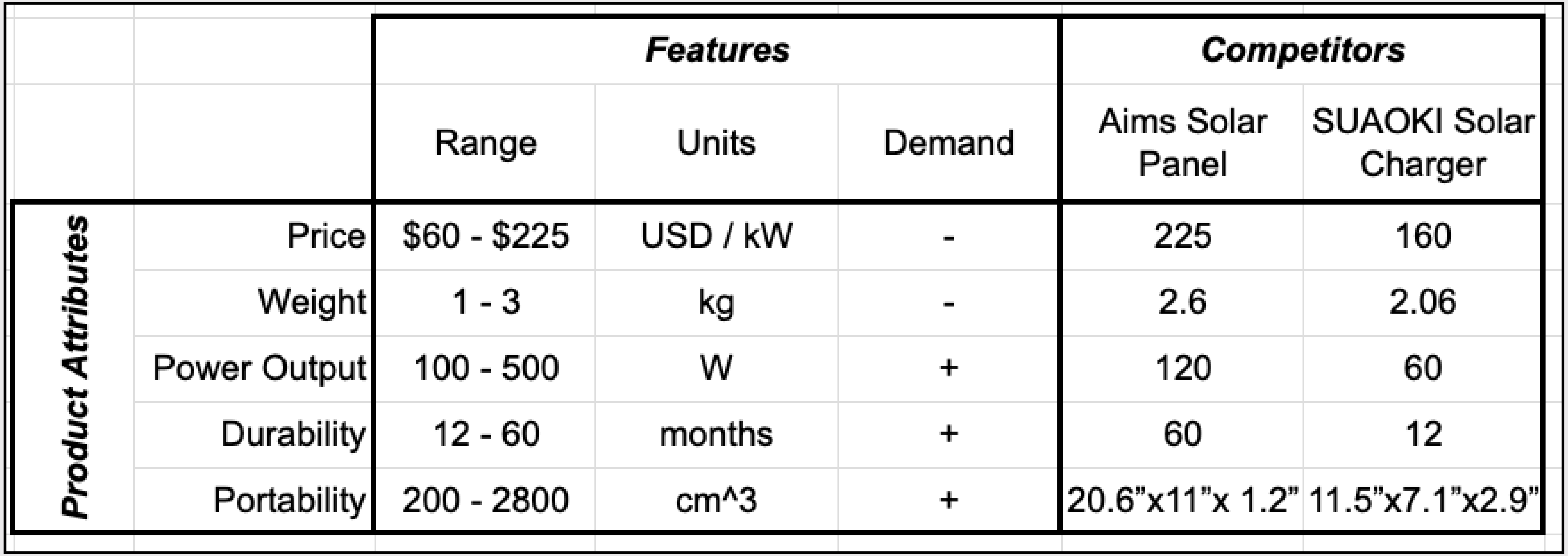
Model Relationships Table (example)



		Features			Competitors	
		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)

Discrete

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

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