Week 3: *RMarkdown & Plotting*

EMSE 6035: Marketing Analytics for Design Decisions

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Week 3: *RMarkdown & Plotting*

1. Intro to RMarkdown

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

Rmarkdown
TEXT. CODE. OUTPUT.
(GET IT TOGETHER, PEOPLE.)
lubr
dplyr
tidy
%>%
ggpl
readr
for
CODE
# HEADERS
italics
LaTe
TEXT
FIGUR
PANDOC
KNITR
FAIRY DUST
YAML
rmarkdown
Horst '19
RECIPE
1. ADD TEXT
2. ADD CODE
3. KNIT
4. (magic)
5. CELEBRATE PERCEIVED WIZARDRY
.Rmd
.md
knitr
pandoc

Art by Allison Horst

Anatomy of a .Rmd file

YAML (**Y**et **A**nother **M**arkdown **L**anguage)

Markdown text

R code

Quick demo

Open `rmd_demo.Rmd`, then click "knit"

Define overall document options in YAML

Basic html page

```
---
title: Your title here
author: Your name here
output: html_document
---
```

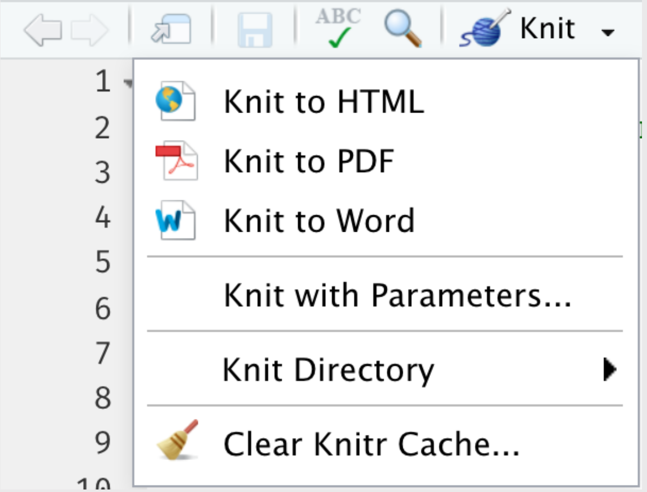
Add table of contents, change theme

```
---
title: Your title here
author: Your name here
output:
  html_document:
    toc: true
    toc_float: true
    theme: flatly
---
```

Other themes at https://bootswatch.com/

Knit to multiple outputs

```r
rmarkdown::render("rmd_demo.Rmd", output_format = "all")
```



```yaml
---
title: Your title here
author: Your name here
output:
  html_document:
    toc: true
    toc_float: true
    theme: flatly
  word_document: default
  pdf_document: default
---
```

Anatomy of a .Rmd file

~~YAML (**Y**et **A**nother **M**arkdown **L**anguage)~~

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

Back to `rmd_demo.Rmd`

Anatomy of a .Rmd file

~~YAML (**Y**et **A**nother **M**arkdown **L**anguage)~~

~~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}
bears %>%
  count(month)
```
~~~

...will produce this when compiled:

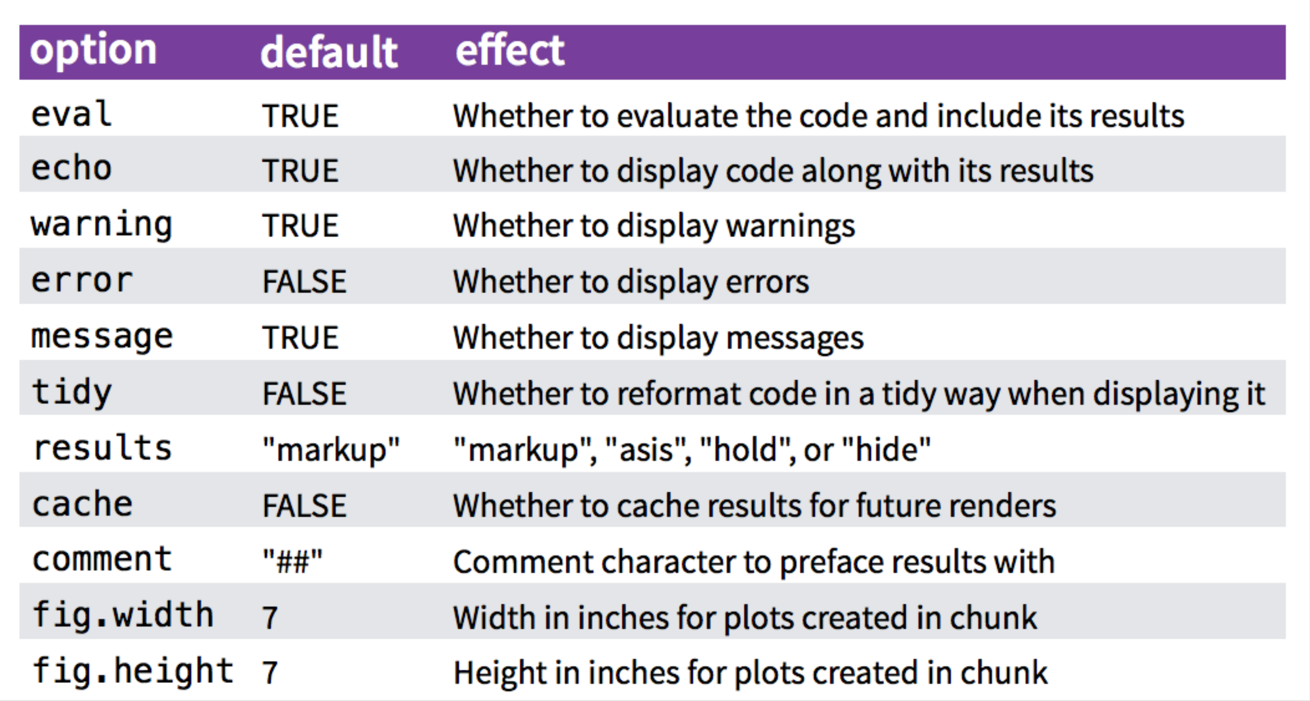
```
bears %>%
  count(month)
```

```
#> # A tibble: 12 × 2
#>    month     n
#>    <dbl> <int>
#>  1     1     3
#>  2     2     1
#>  3     3     1
#>  4     4     4
#>  5     5    18
#>  6     6    20
#>  7     7    27
#>  8     8    28
#>  9     9    25
#> 10    10    25
#> 11    11    12
```

Chunk options

Control what chunks output using options inside `{r}`:

Example: `{r, echo=FALSE, message=FALSE}`



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 🌍

One chunk to rule them all!

~~~
```{r setup, include = FALSE}
knitr::opts_chunk$set(
  warning = FALSE,
  message = FALSE,
  comment = "#>",
  fig.retina = 3,
  fig.path = "figs/"
)
```
~~~

- A special chunk label: `setup`
- Typically the first chunk
- All following chunks will use these options (i.e., sets global chunk options)
- **Tip**: set `include=FALSE`
- You can (and should) use individual chunk options too

Your turn

15:00

1) Open the `bears.Rmd` 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 `rmd_demo.Rmd` file!).

3) Use text and code to find answers each of the following questions - show your code and results to justify each answer:

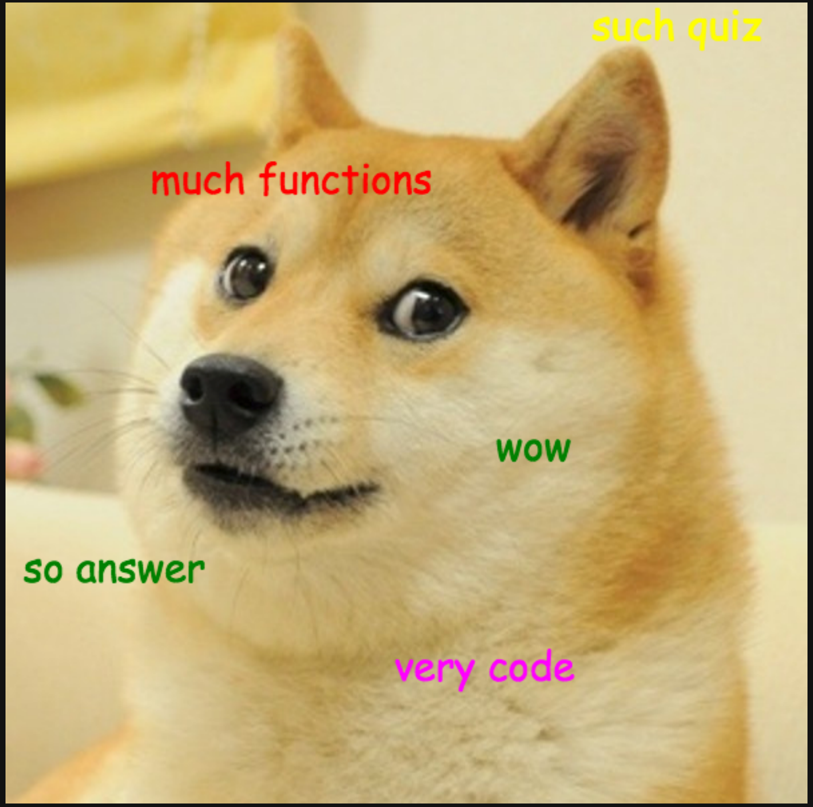
- Which months have the highest frequency of bear killings?
- Who has been killed more often by bears: hunters or hikers?
- How do the the number of bear attacks on men vs women compare?

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

Quiz 1

Link is in the #class channel

10:00



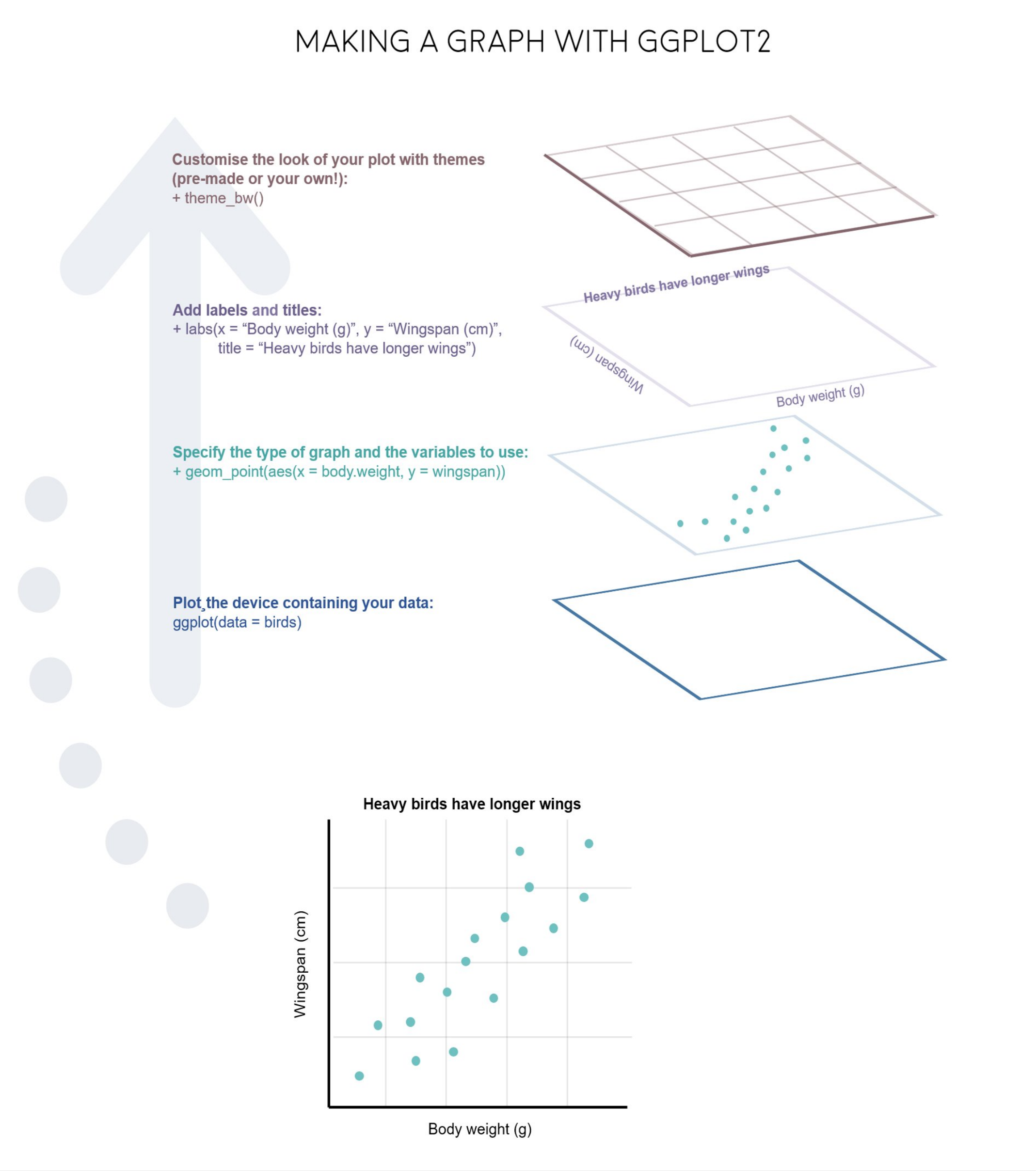
Week 3: *RMarkdown & Plotting*

1. Intro to RMarkdown

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

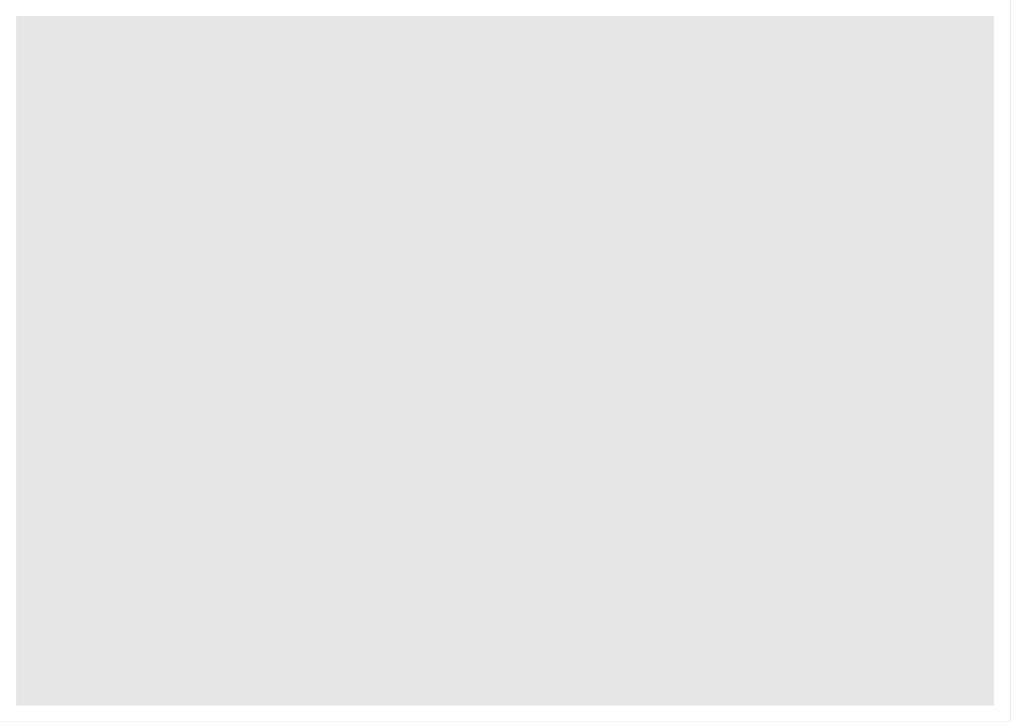
```r
head(mpg)
```

```
#> # 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

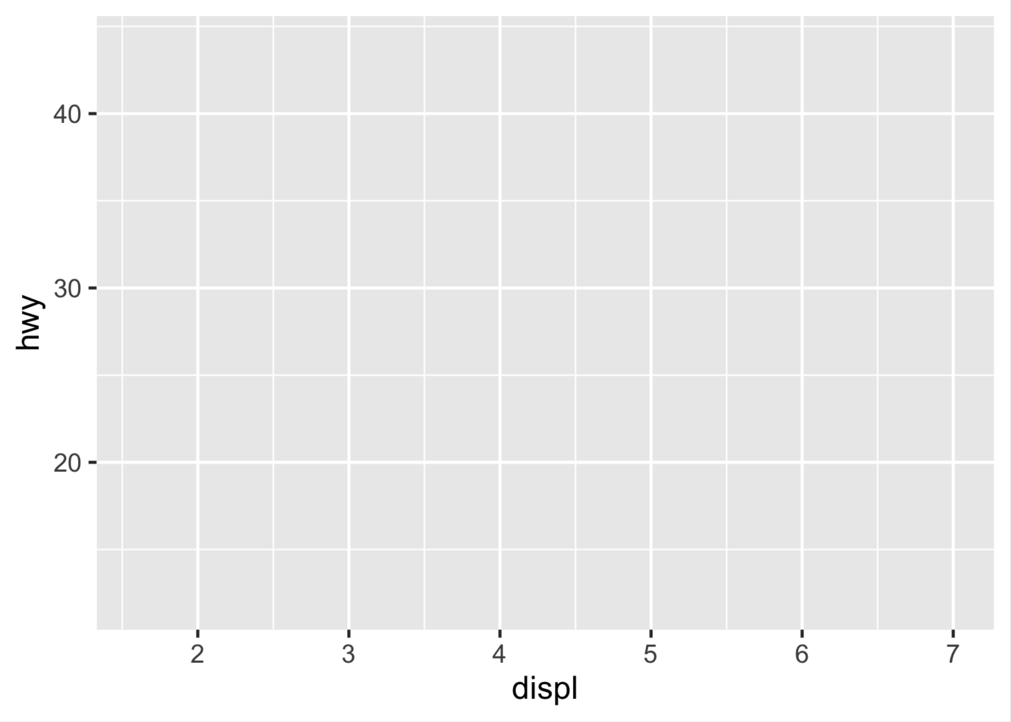
```
mpg %>%
  ggplot()
```



Layer 2: The aesthetic mapping

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

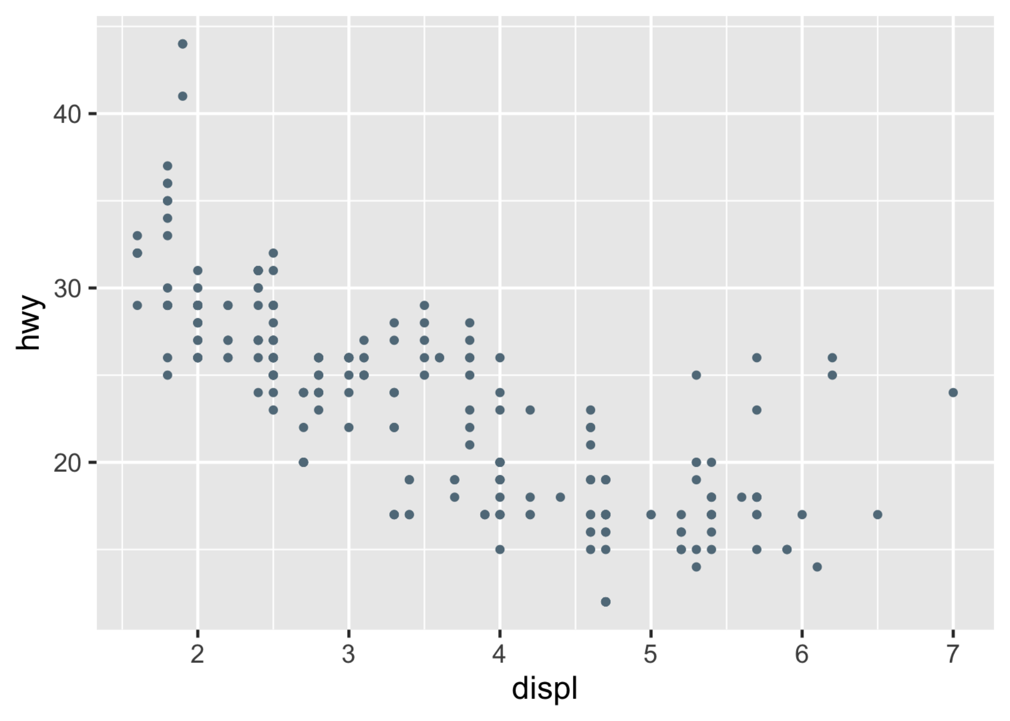
```
mpg %>%
  ggplot(aes(x = displ, y = hwy))
```



Layer 3: The geometries

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

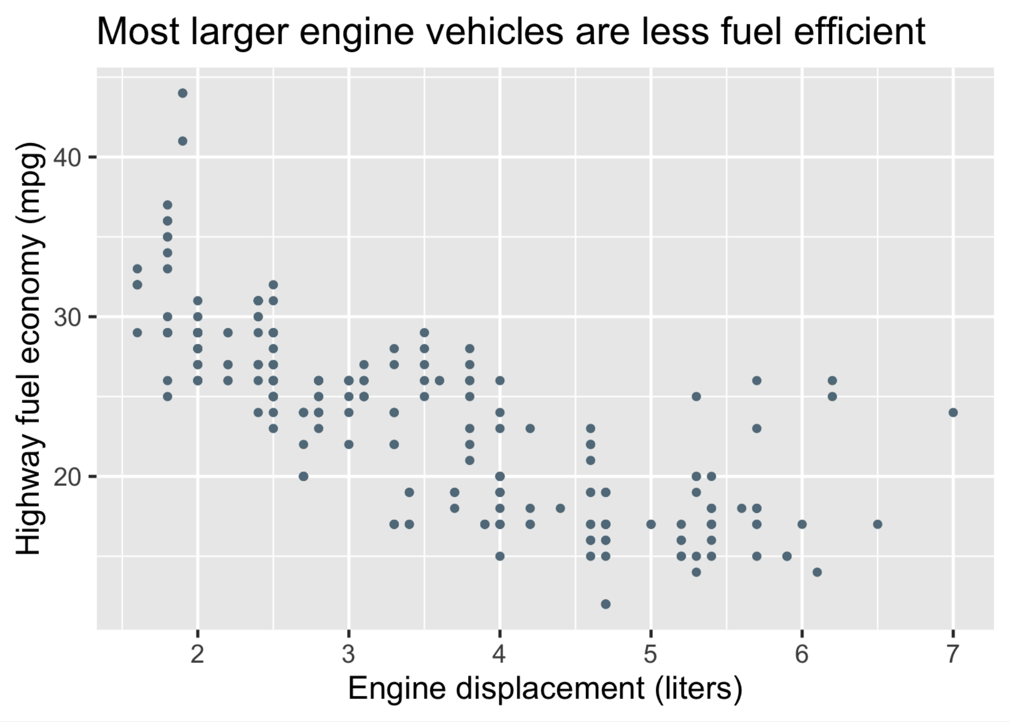
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point()
```



Layer 4: The annotations / labels

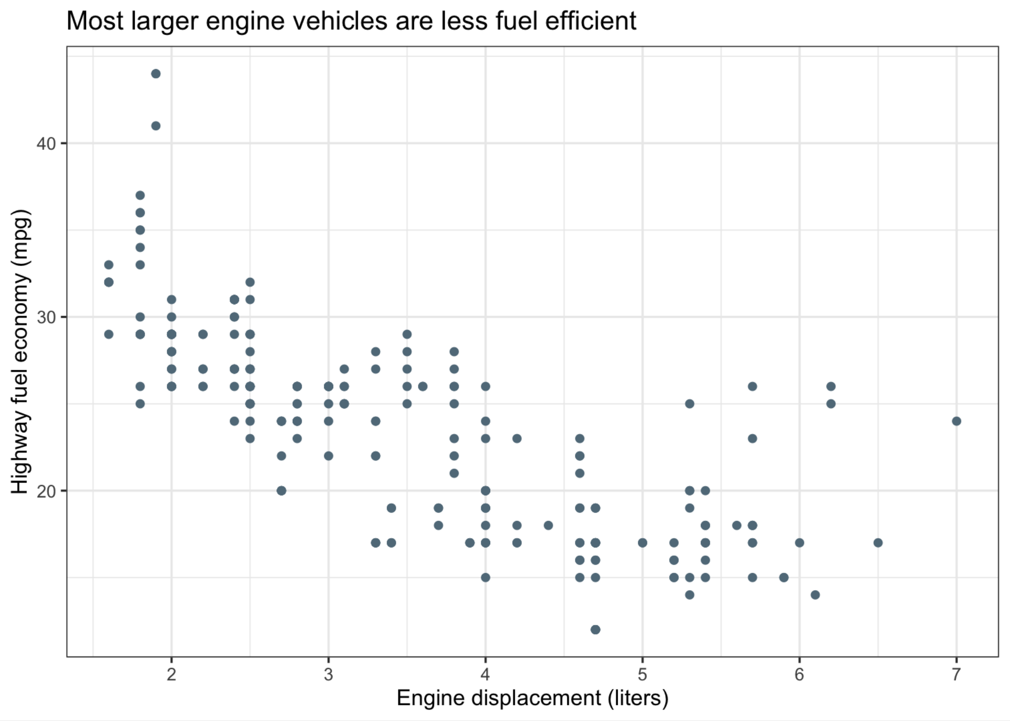
Use `labs()` to modify most labels

```
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

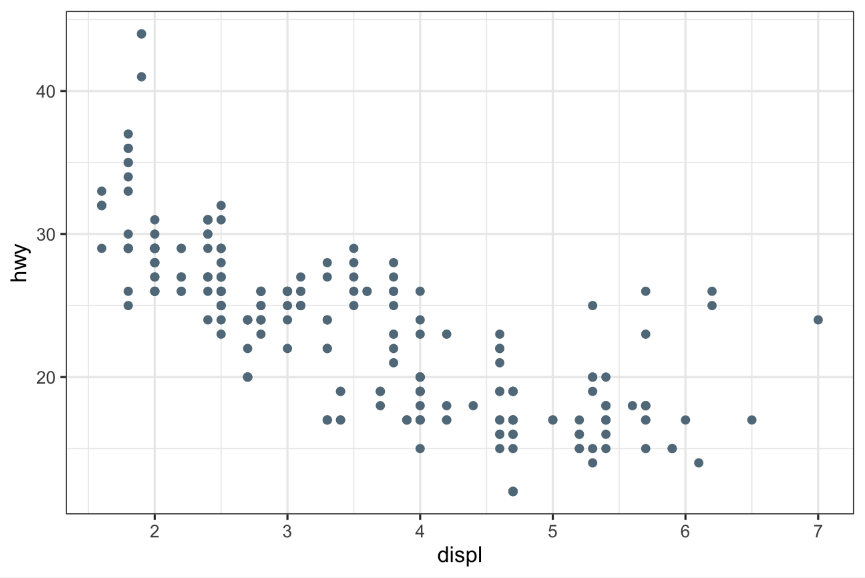
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  labs(
    x = "Engine displacement (liters)",
    y = "Highway fuel economy (mpg)",
    title = "Most larger engine vehicles are less fuel efficient"
  ) +
  theme_bw()
```



Common themes

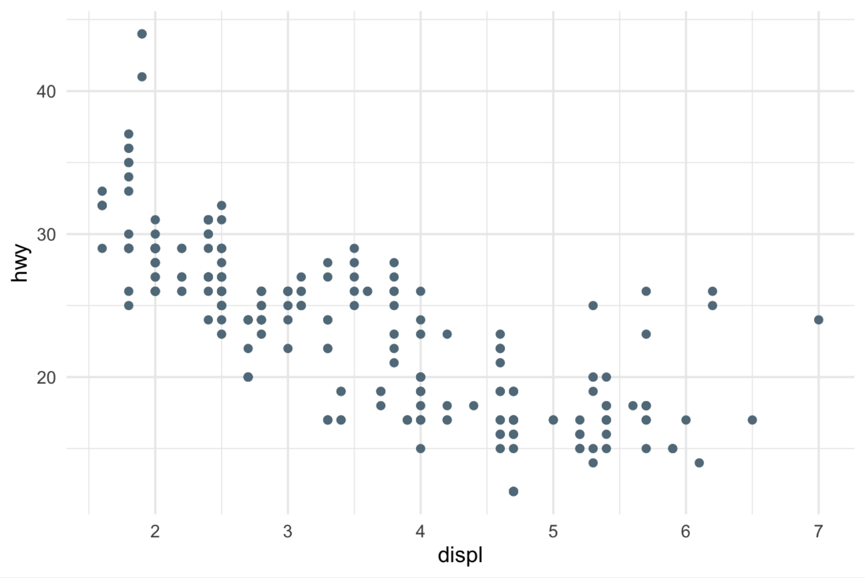
theme_bw()

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



theme_minimal()

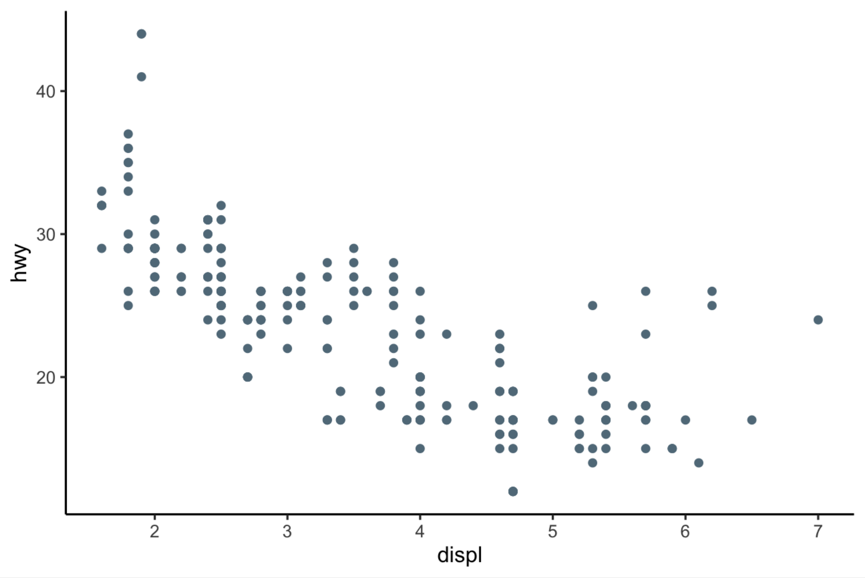
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  theme_minimal()
```



Common themes

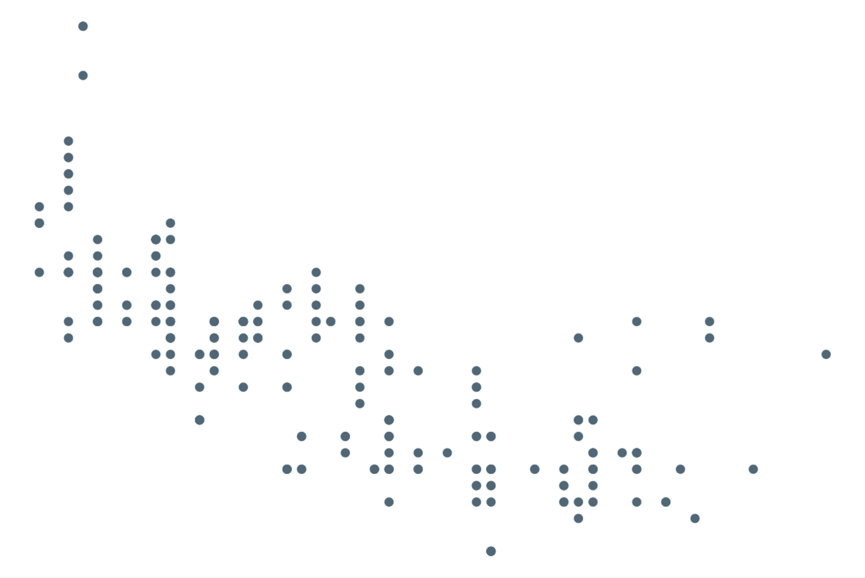
`theme_classic()`

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



`theme_void()`

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

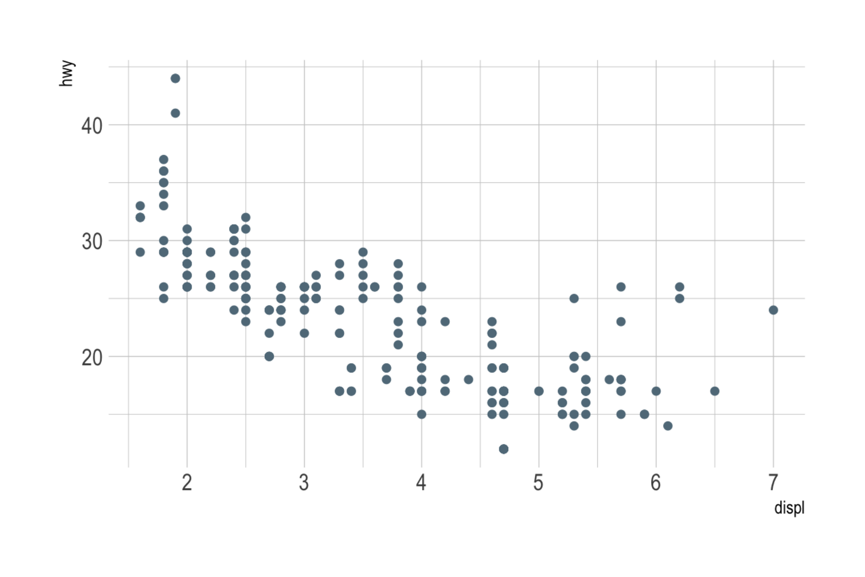


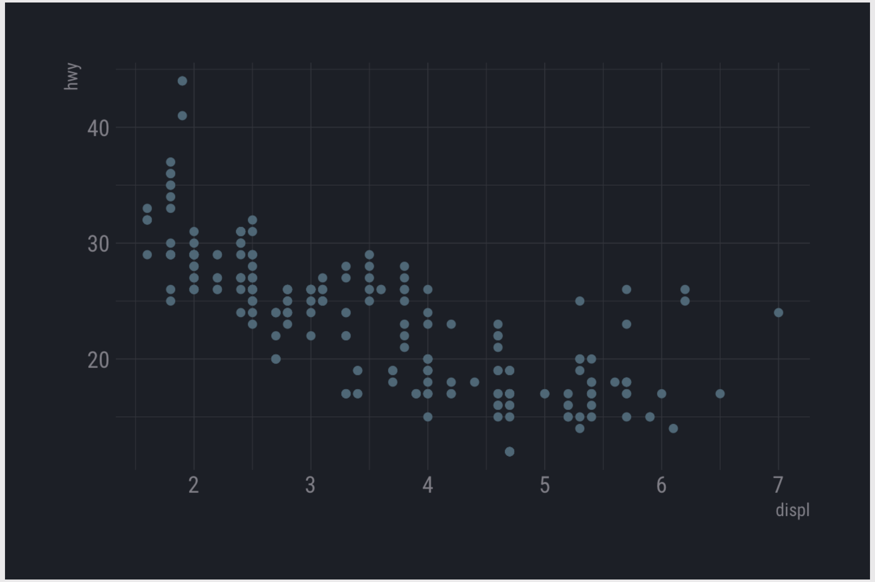
Other themes: hrbrthemes

```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()
```



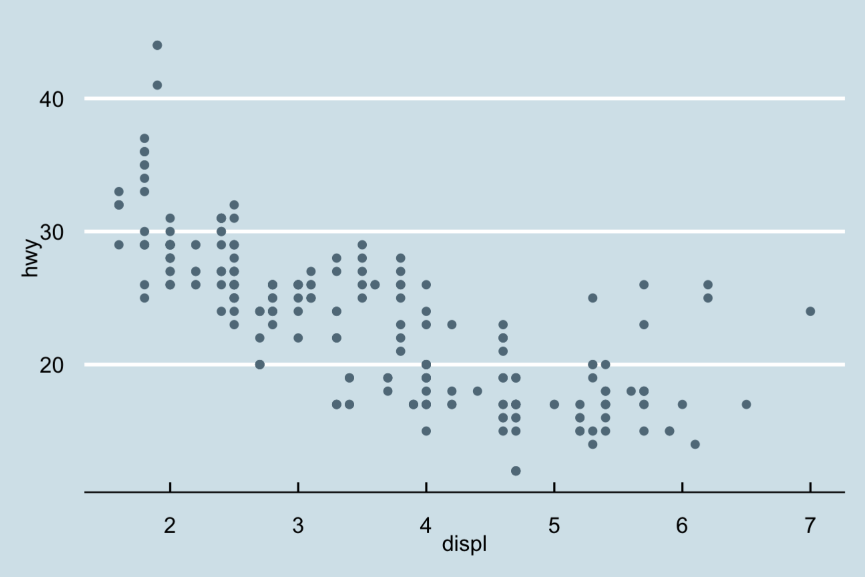


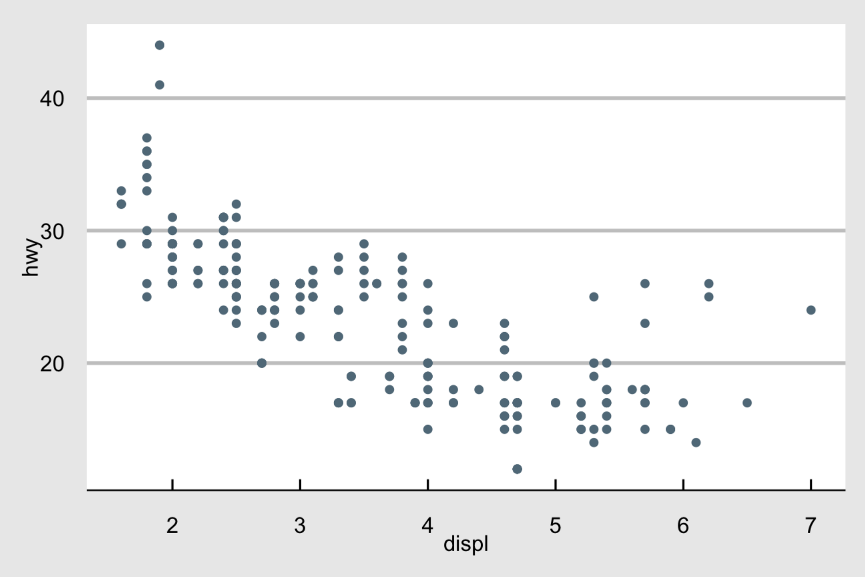
Other themes: ggthemes

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

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

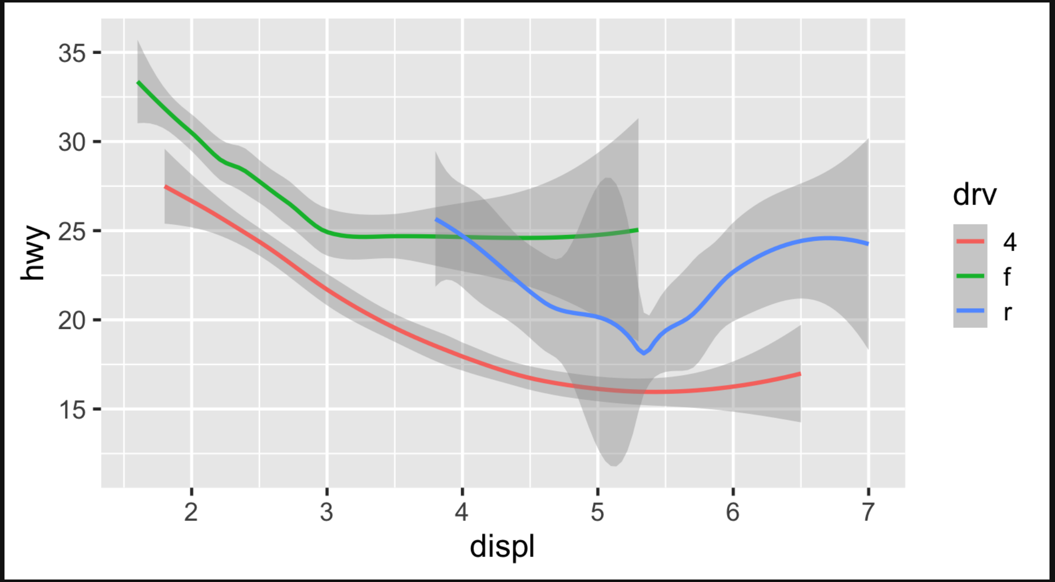
```
mpg %>%
  ggplot(aes(x = displ, y = hwy)) +
  geom_point() +
  ggthemes::theme_economist_white()
```

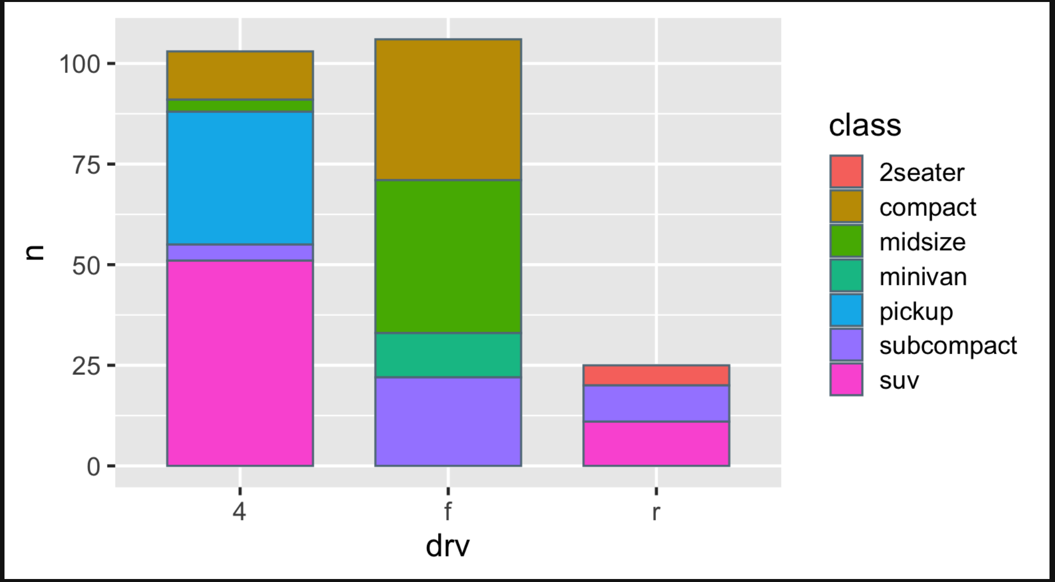




More practice

Open `ggplot2.Rmd`

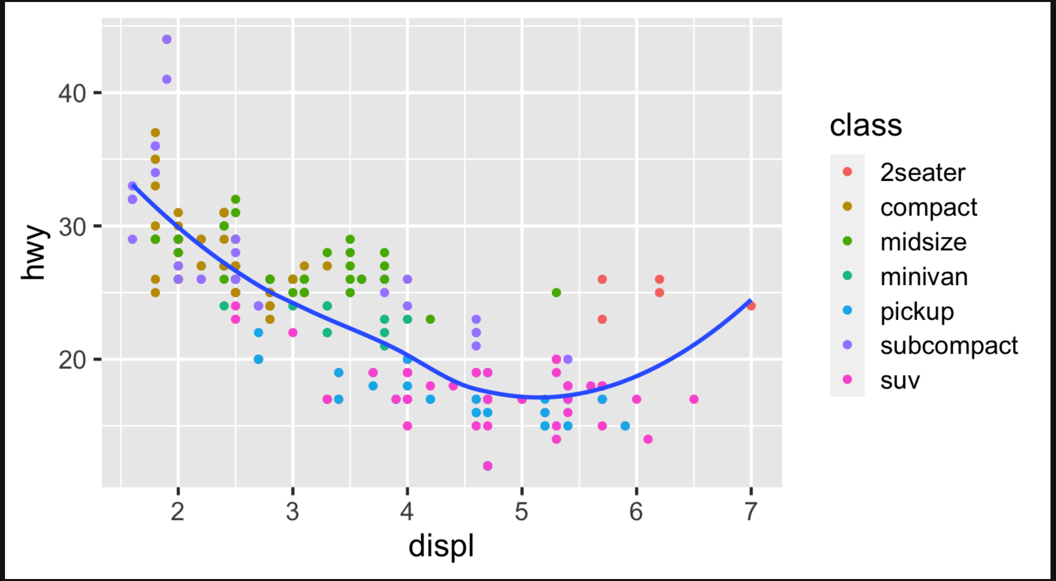




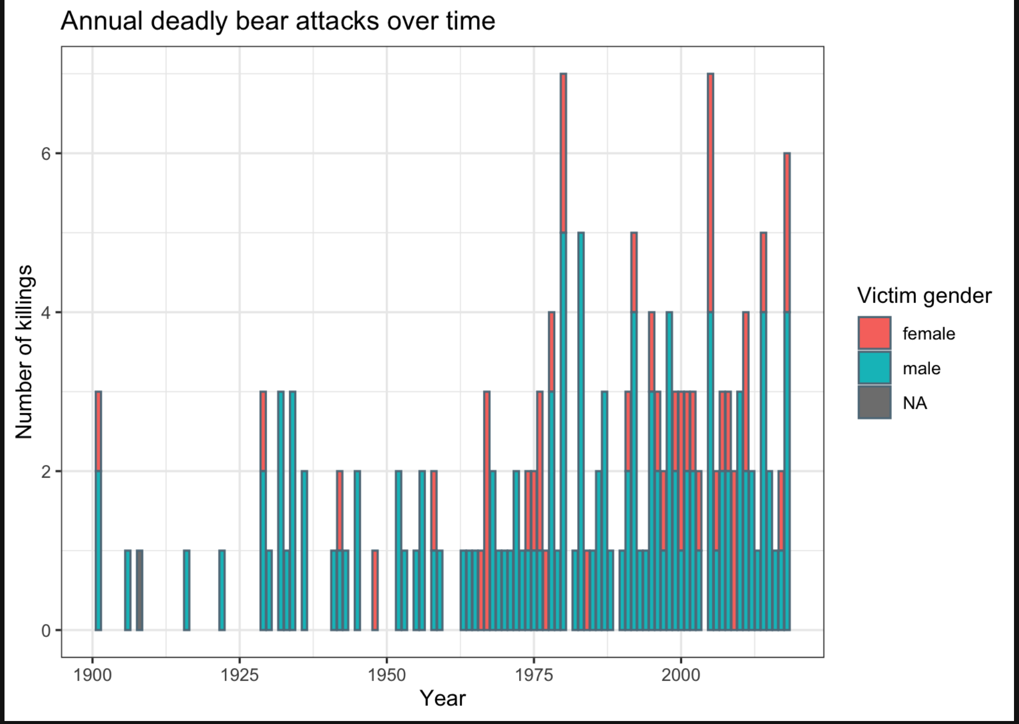
Your turn

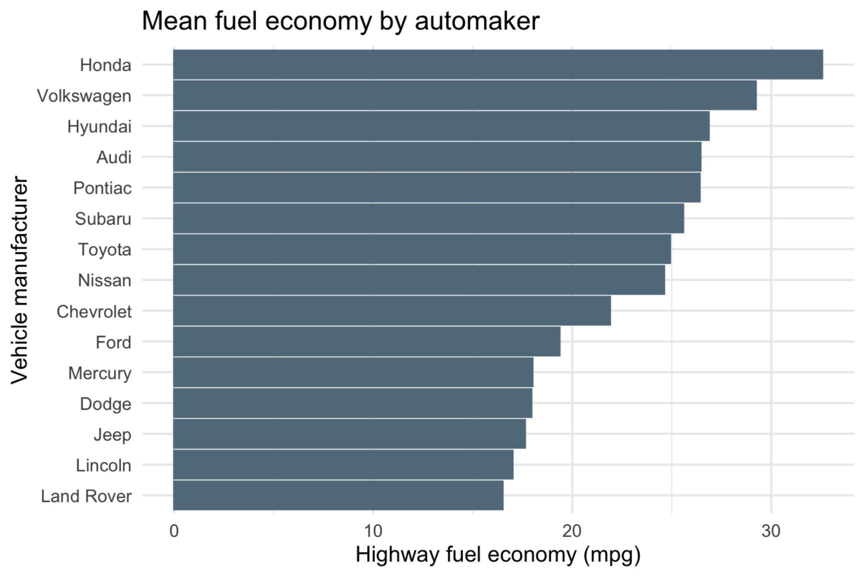
15:00

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



Extra practice





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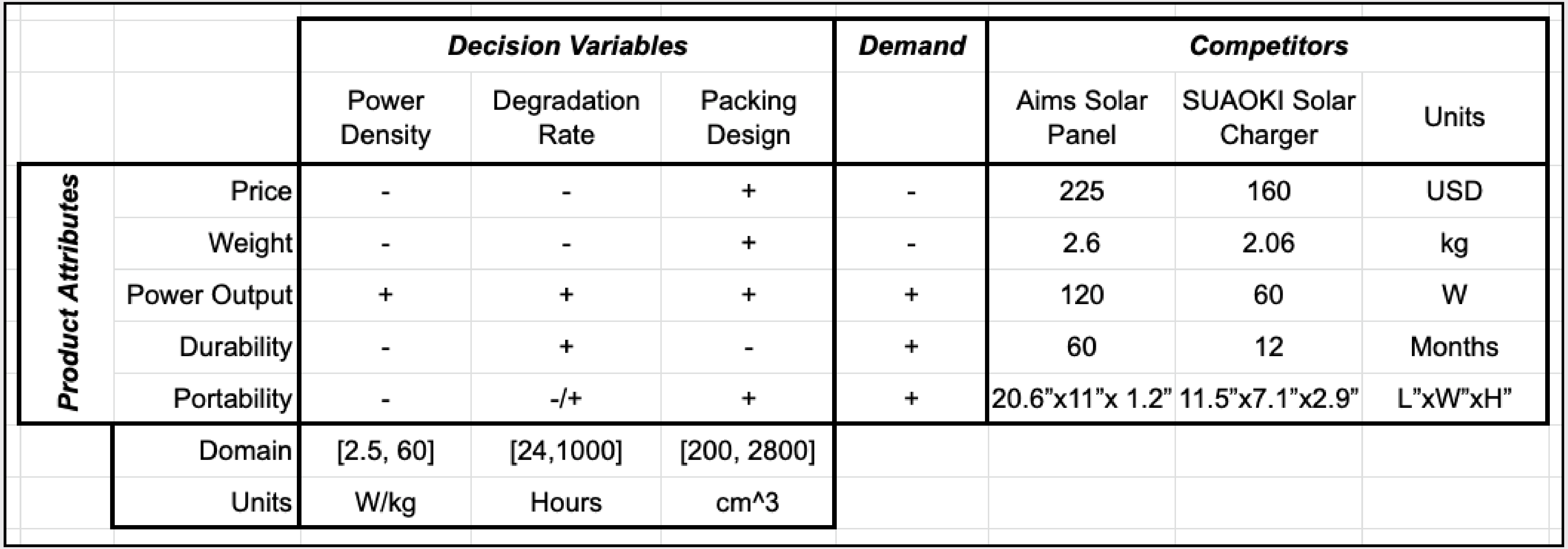
Model Relationships Table (example)



		Decision Variables			Demand	Competitors		
		Power Density	Degradation Rate	Packing Design		Aims Solar Panel	SUAOKI Solar Charger	Units
Product Attributes	Price	-	-	+	-	225	160	USD
	Weight	-	-	+	-	2.6	2.06	kg
	Power Output	+	+	+	+	120	60	W
	Durability	-	+	-	+	60	12	Months
	Portability	-	-/+	+	+	20.6”x11”x 1.2”	11.5”x7.1”x2.9”	L”xW”xH”
	Domain	[2.5, 60]	[24,1000]	[200, 2800]				
	Units	W/kg	Hours	cm^3				

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)