

Class05: Data Visualization with ggplot

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Background: *comparing “base” and ggplot2*

There are many graphics systems available in R. These include “base” R and tons of add on packages, like **ggplot2**.

Let’s compare “base” and **ggplot** briefly. We can use some example data that is built-in with R called **cars**:

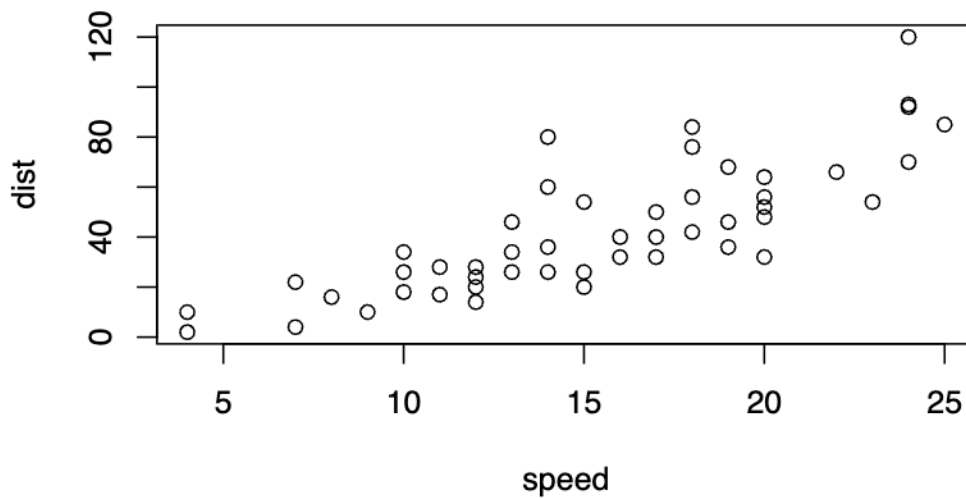
```
head(cars)
```

```
      speed dist
1         4    2
2         4   10
3         7    4
4         7   22
```

```
5      8    16
6      9    10
```

In base R I can just call `plot()`

```
plot(cars)
```



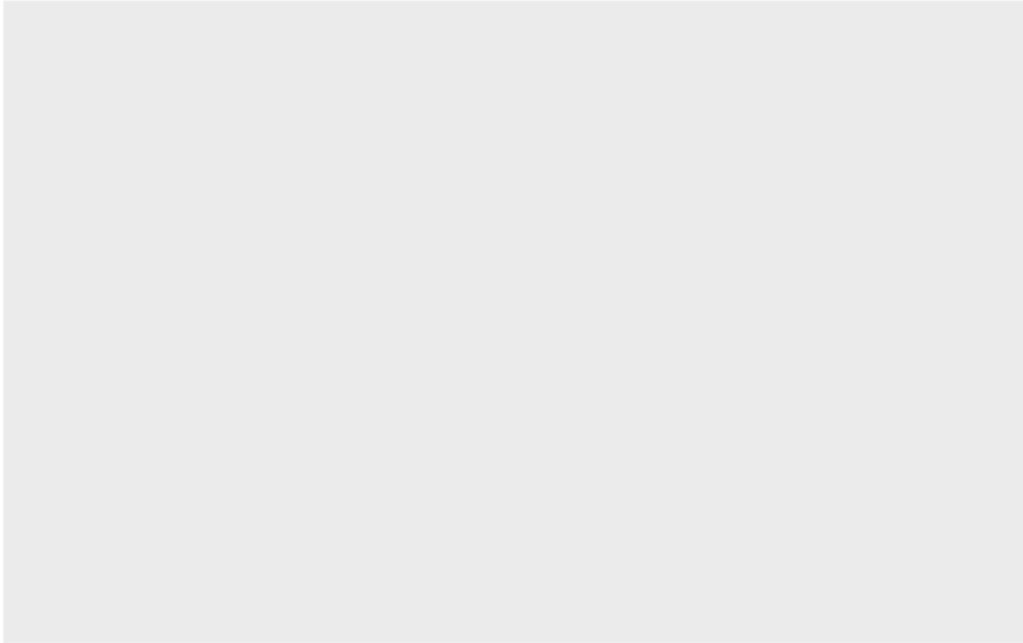
How can we do this with ggplot2?

First, we need to install the package. We do this with `install.packages("ggplot2")`. I only need to do this once and then it will be available on my computer so I don't need to re-install it.

Key point: I only install packages in the R console, not within quarto docs or R scripts.

Before I use any add on package, I must load it up with a call to `library()`

```
library(ggplot2)
ggplot(cars)
```

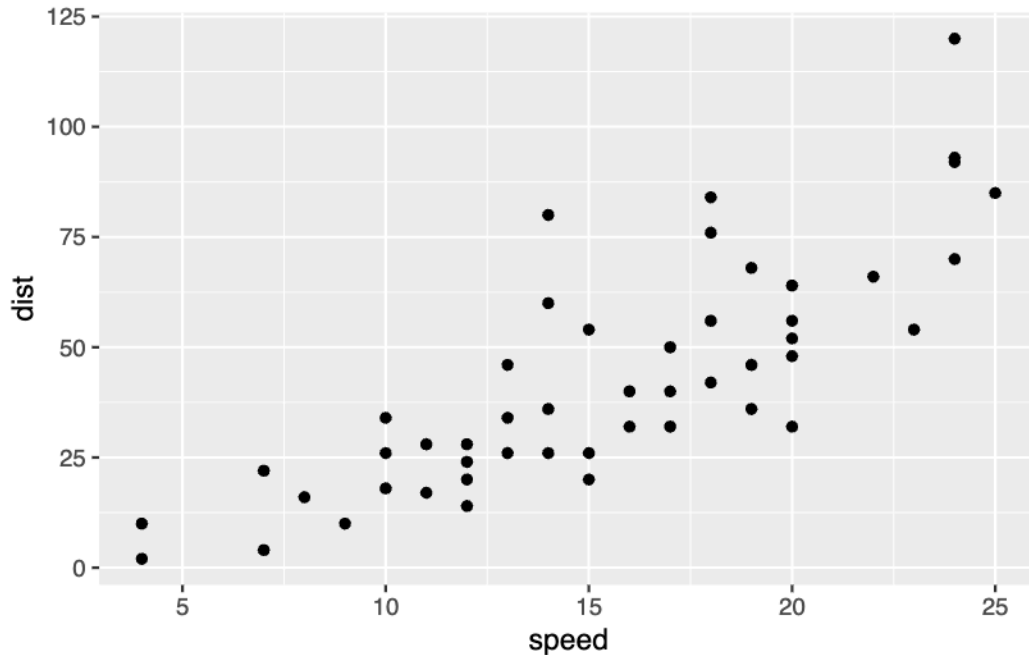


This doesn't yield a very interesting plot.

Every ggplot has at least 3 things (called layers).

- the **data** (in our case, **cars**)
- the **aesthetics** (how the data map to the plot)
- the **geometries** that determine how the plot is drawn (lines, points, columns, etc.)

```
ggplot(cars) +  
  aes(x=speed, y=dist) +  
  geom_point()
```



There we go!

For “simple” plots, ggplot is much more verbose than base R, as it involves more typing. But, the defaults are nicer and for complicated plots it becomes much more efficient and structured.

Q. Add a line to show the relationship of speed to stopping distance (i.e. add another “layer”).

```
p <- ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point() +
  geom_smooth(se=FALSE, method="lm")
```

note: to save the plot, we assign it to “p”.

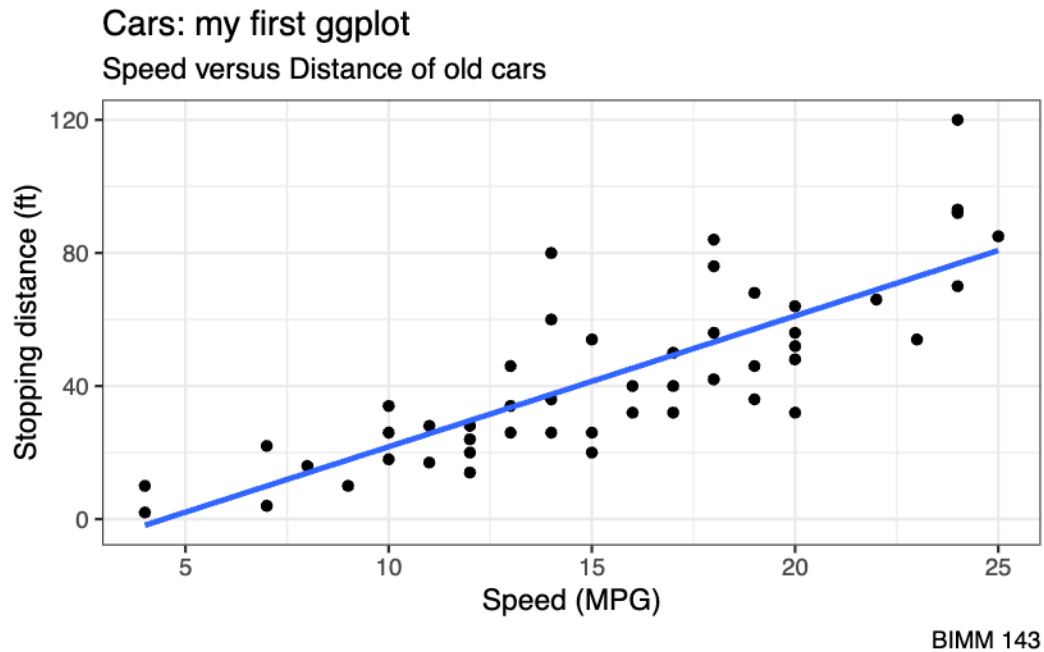
Q. Add a title and subtitle to the plot.

I can always save any ggplot object (i.e. plot) and then use it later for adding more layers:

```
p + labs(title = "Cars: my first ggplot",
  subtitle = "Speed versus Distance of old cars",
  caption = "BIMM 143",
  x = "Speed (MPG)",
```

```
y = "Stopping distance (ft)" +  
theme_bw()
```

```
`geom_smooth()` using formula = 'y ~ x'
```



Gene expression plot

Read input data into R

```
url <- "https://bioboot.github.io/bimm143_S20/class-material/up_down_expression.txt"  
genes <- read.delim(url)  
head(genes)
```

	Gene	Condition1	Condition2	State
1	A4GNT	-3.6808610	-3.4401355	unchanging
2	AAAS	4.5479580	4.3864126	unchanging
3	AASDH	3.7190695	3.4787276	unchanging
4	AATF	5.0784720	5.0151916	unchanging
5	AATK	0.4711421	0.5598642	unchanging
6	AB015752.4	-3.6808610	-3.5921390	unchanging

Q. How many genes are in this wee database?

```
nrow(genes)
```

```
[1] 5196
```

Q. How many columns are there?

```
ncol(genes)
```

```
[1] 4
```

Q. What are the column names?

```
colnames(genes)
```

```
[1] "Gene"          "Condition1" "Condition2" "State"
```

Q. How many “up” and “down” regulated genes are there?

```
table(genes$"State")
```

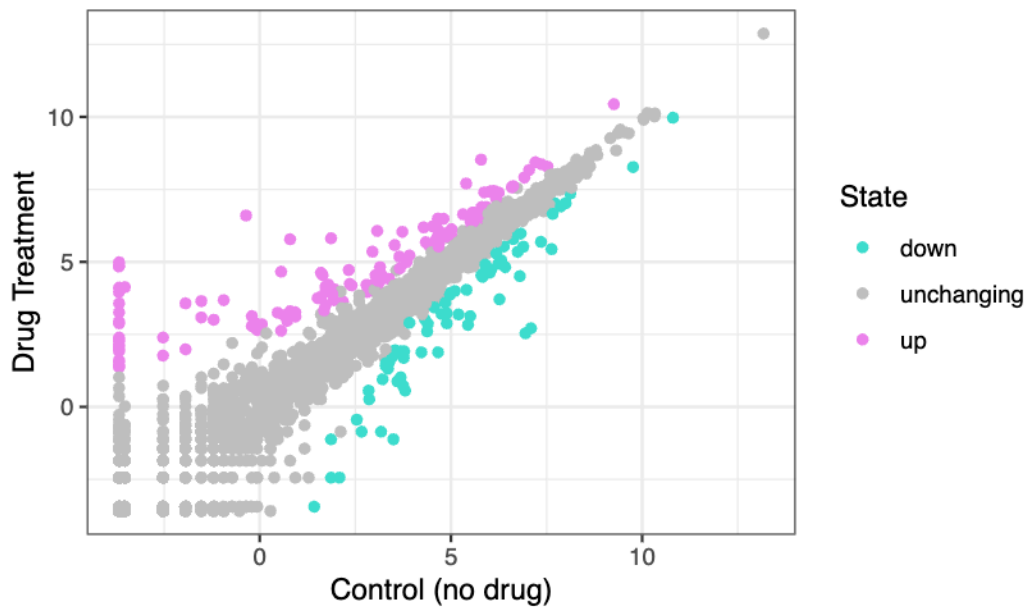
down	unchanging	up
72	4997	127

Custom color plot

Q. Make a first plot of this data

```
ggplot(genes) +  
  aes(x=Condition1, y=Condition2, col=State) +  
  scale_color_manual(values=c("turquoise", "gray", "violet")) +  
  geom_point() +  
  labs(title="Gene expression changes upon drug treatment", x="Control (no drug)", y="Drug T  
  theme_bw()
```

Gene expression changes upon drug treatment



Using different geoms

Let's plot some aspects of the in-built `mtcars` dataset

```
head(mtcars)
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.460	20.22	1	0	3	1

Q. Scatter plot of `mpg` vs `disp`

```
p1 <- ggplot(mtcars) +  
  aes(x=mpg, y=disp) +  
  geom_point()
```

Q. Boxplot of `gear` vs `disp`

```
p2 <- ggplot(mtcars) +  
  aes(x=gear, y=disp, group=gear) +  
  geom_boxplot()
```

Q. Barplot of carb

```
p3 <- ggplot(mtcars) +  
  aes(carb) +  
  geom_bar()
```

Q. Smooth of disp vs qsec

```
p4 <- ggplot(mtcars) +  
  aes(x=disp, y=qsec) +  
  geom_smooth()
```

Combining plots into a figure

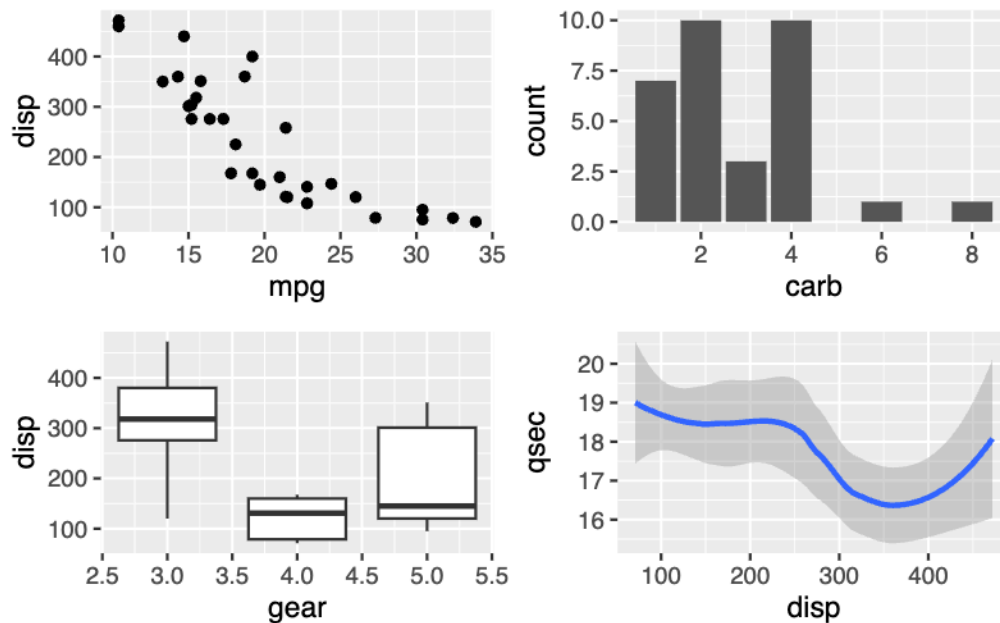
I want to combine all these plots into one figure with multiple panels.

We can use the **patchwork** package to do this.

Note: (install.packages("patchwork") was used to install this package in the R console.)

```
library(patchwork)  
  
(p1 / p2 | p3 / p4)
```

`geom_smooth()` using method = 'loess' and formula = 'y ~ x'



```
ggsave(filename="myplot.png", width=10, height=10)
```

``geom_smooth()`` using method = 'loess' and formula = 'y ~ x'

Faceting

```
#File location online
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.ts"

gapminder <- read.delim(url)
```

And a wee peek

```
head(gapminder, 10)
```

	country	continent	year	lifeExp	pop	gdpPercap
1	Afghanistan	Asia	1952	28.801	8425333	779.4453
2	Afghanistan	Asia	1957	30.332	9240934	820.8530
3	Afghanistan	Asia	1962	31.997	10267083	853.1007

4	Afghanistan	Asia	1967	34.020	11537966	836.1971
5	Afghanistan	Asia	1972	36.088	13079460	739.9811
6	Afghanistan	Asia	1977	38.438	14880372	786.1134
7	Afghanistan	Asia	1982	39.854	12881816	978.0114
8	Afghanistan	Asia	1987	40.822	13867957	852.3959
9	Afghanistan	Asia	1992	41.674	16317921	649.3414
10	Afghanistan	Asia	1997	41.763	22227415	635.3414

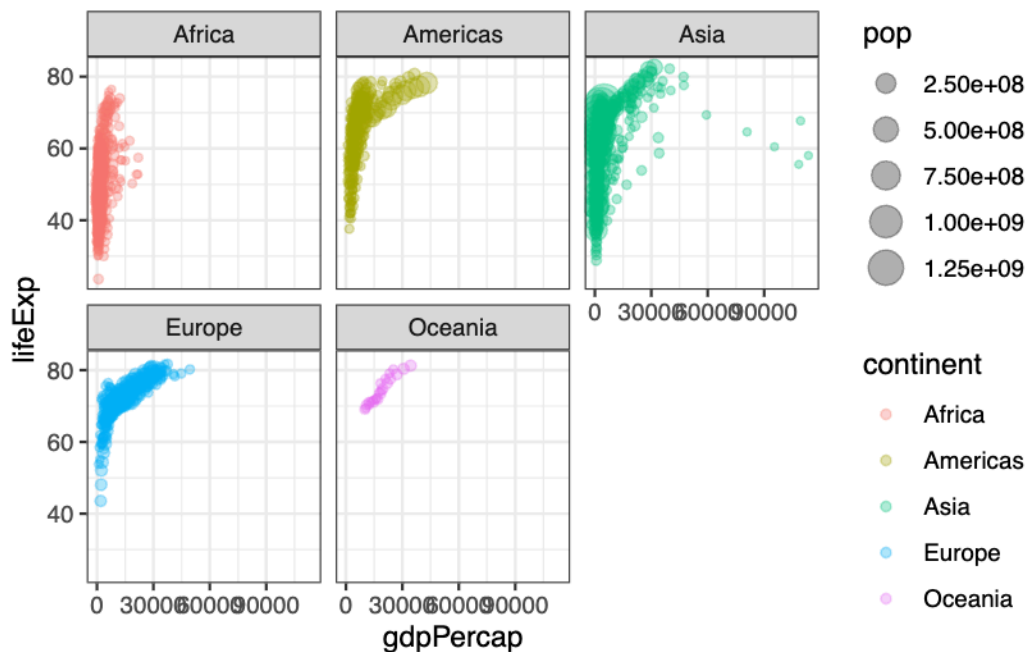
Q. How many countries are in this dataset?

```
length(table(gapminder$country))
```

[1] 142

Q. Plot gdpPercap vs lifeExp color by continent

```
ggplot(gapminder) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.3) +
  facet_wrap(~continent) +
  theme_bw()
```



Renee's notes on Quarto- *the basics*

1. The heading above is a level two heading- preceded by two pound signs and a space. (A level 1 heading is larger and preceded by 1 pound sign and a space).
2. To put font in italics, *you surround it by two asterisks*
3. To put font in bold, **you surround it by four asterisks**

How to run code

You can embed code by creating code chunks:

```
"code chunk" <- (1:10)
```

To create a chunk, you can add *three back-ticks* (“”), then the type of code you are using *in mustache brackets* ({}).

OR you can hit option + command + i (for mac)