Class 5: Data visualization

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Base R graphics vs ggplot2

There are many graphics systems available in R, including so-called "base" R graphics and the very popular **ggplot2** package.

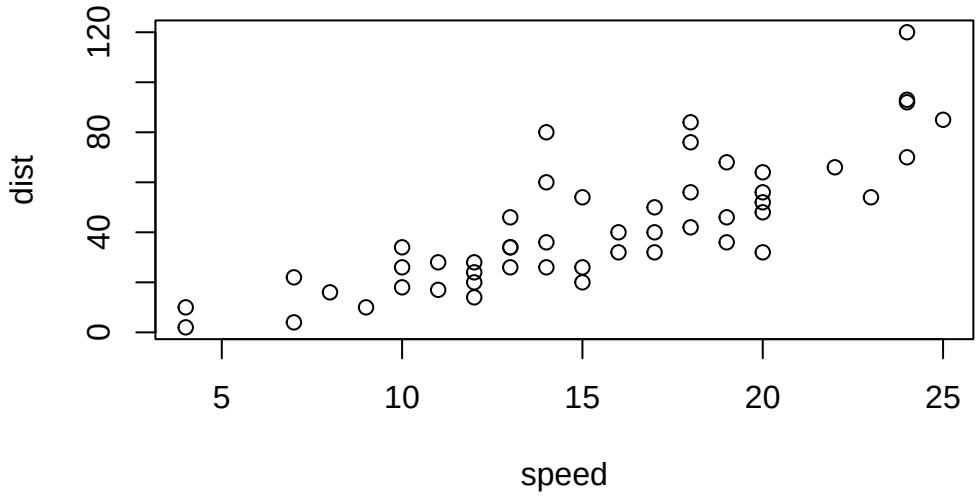
To compare these let's play with the inbuilt `cars`dataset.

```
head(cars)
```

```
  speed dist
1     4    2
2     4   10
3     7    4
4     7   22
5     8   16
6     9   10
```

To use "base" R I can simply call the `plot()` function:

```
plot(cars)
```



To use `ggplot2` package I first need to install it with the function `install.packages("ggplot2")`.

I will run this in my R console (i.e. the R brain) as I do not want to re-install it every time I render my report…

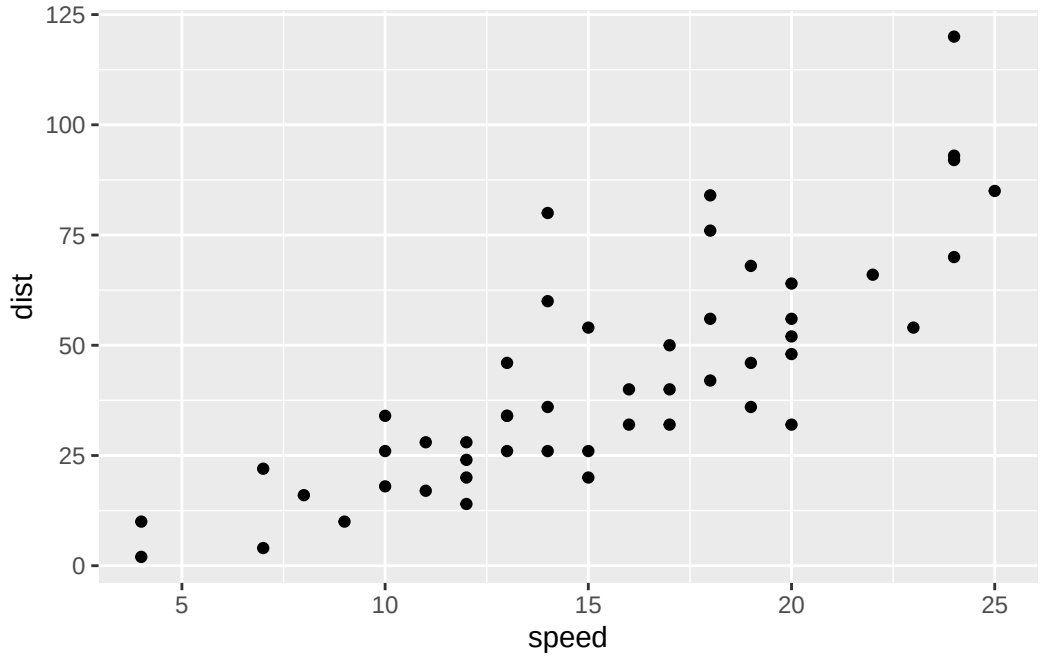
The main function in this package is called `ggplot()`. Can I just call it

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

To make a figure with ggplot I need always at least 3 things:

- **Data** (i.e. What I want to plot.)
- **Aes** (The aesthetic mapping of the data to the plot I want.)
- **The Geoms** (i.e. How I want to plot the data.)

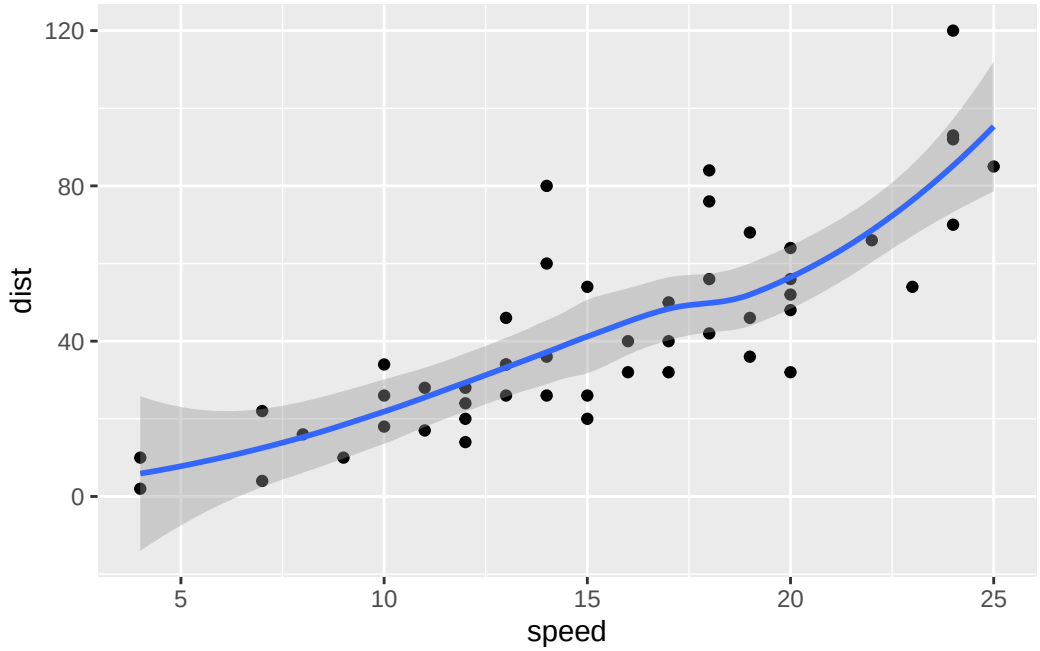
```
ggplot(data=cars) +
  aes(x=speed, y=dist) +
  geom_point()
```



Let's make a plot with a smooth line

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

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

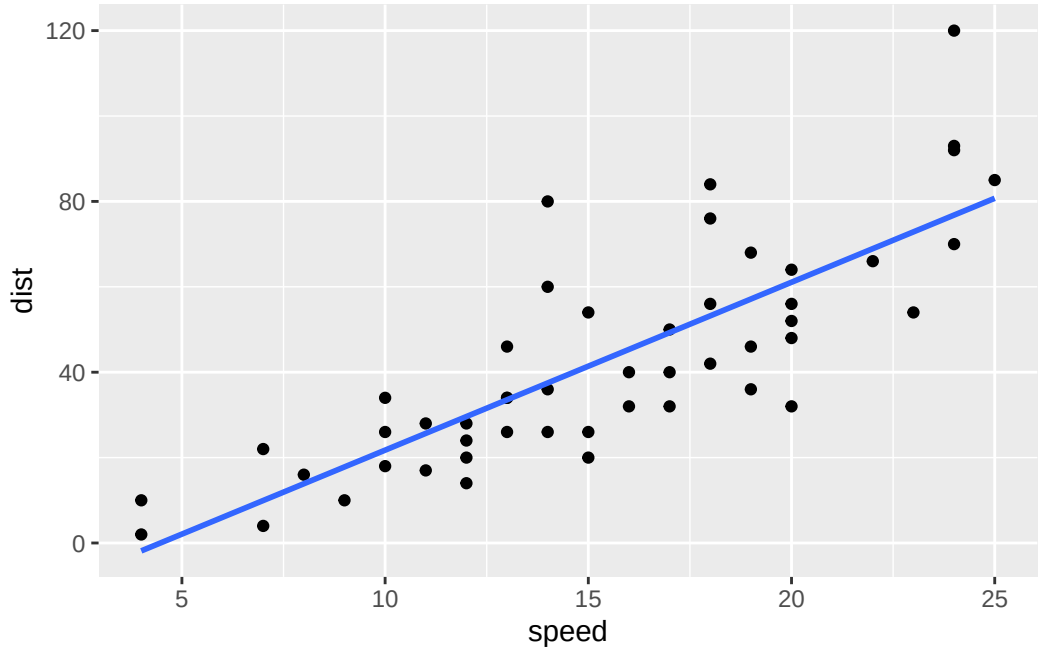


Ggplot is much more verbose that base R plot but it has a consistent layer system that I can use to make just about my plot.

Let's make a plot with a straight line fit - i.e. a linear model and no standard error shown.

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

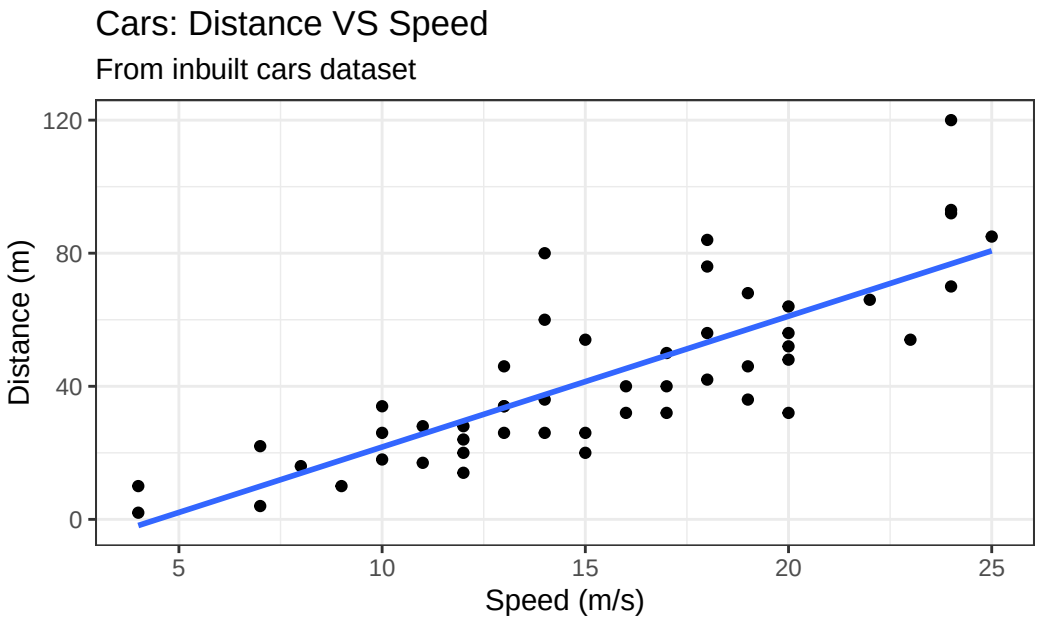
```
`geom_smooth()` using formula = 'y ~ x'
```



Adding various labels & annotations with the labs() function and changing the plot look to a more conservative "black & white" theme by adding the theme_bw() function:

```
ggplot(data=cars) +
  aes(x=speed, y=dist) +
  geom_point() +
  geom_smooth(se=FALSE, method="lm") +
  labs(title="Cars: Distance VS Speed",
       subtitle="From inbuilt cars dataset",
       caption="The data gives the speed of cars and the distances taken to stop. Note tha
       x="Speed (m/s)",
       y="Distance (m)") +
  theme_bw()
```

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



s the speed of cars and the distances taken to stop. Note that the data were recorded in the 1920s.

A more complicated plot

Let's load some gene expression data. The code below reads the results of a differential expression analysis where a new anti-viral drug is being tested.

```
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
```

Q1: How many genes are in this dataset?

```
nrow(genes)
```

```
[1] 5196
```

Q2: How can we summarize that last column - the "State" column?

There are different ways to call genes the "State" column:

- genes[,4]
- genes[,"State"]
- genes$State

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

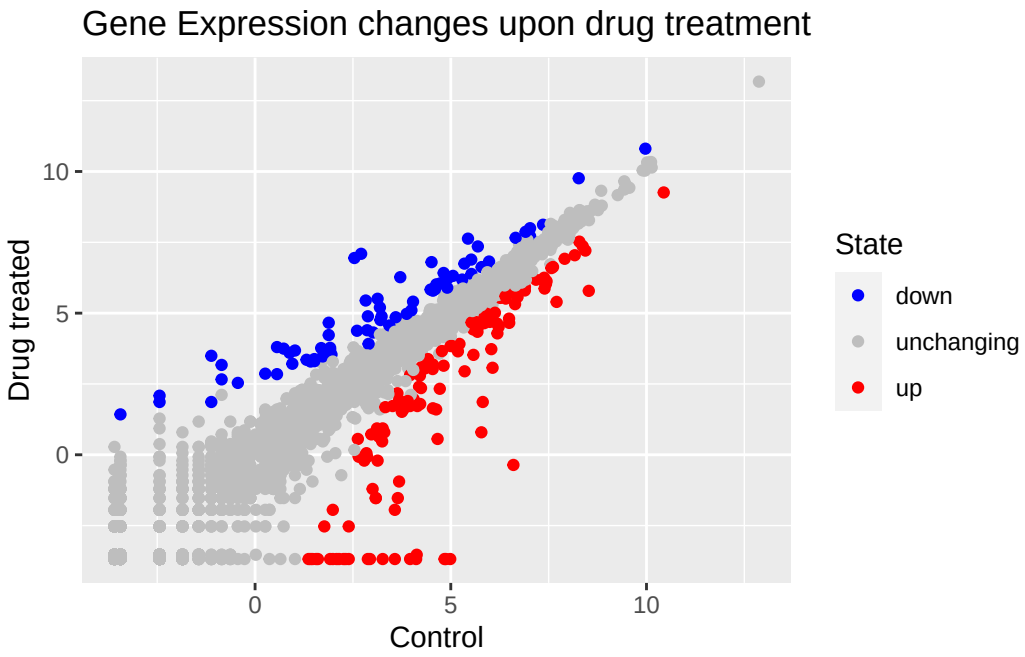
```
      down unchanging         up
        72       4997        127
```

Note we can save our plot as an object and use it later to add more layers:

```
p <- ggplot(genes) +
  aes(x=Condition2, y=Condition1, color=State) +
  geom_point()
```

I can now just call `p` when I want to plot or add to it.

```
p + labs(title="Gene Expression changes upon drug treatment",
         x="Control",
         y="Drug treated") +
  scale_colour_manual(values=c("blue", "gray", "red"))
```



Going Further

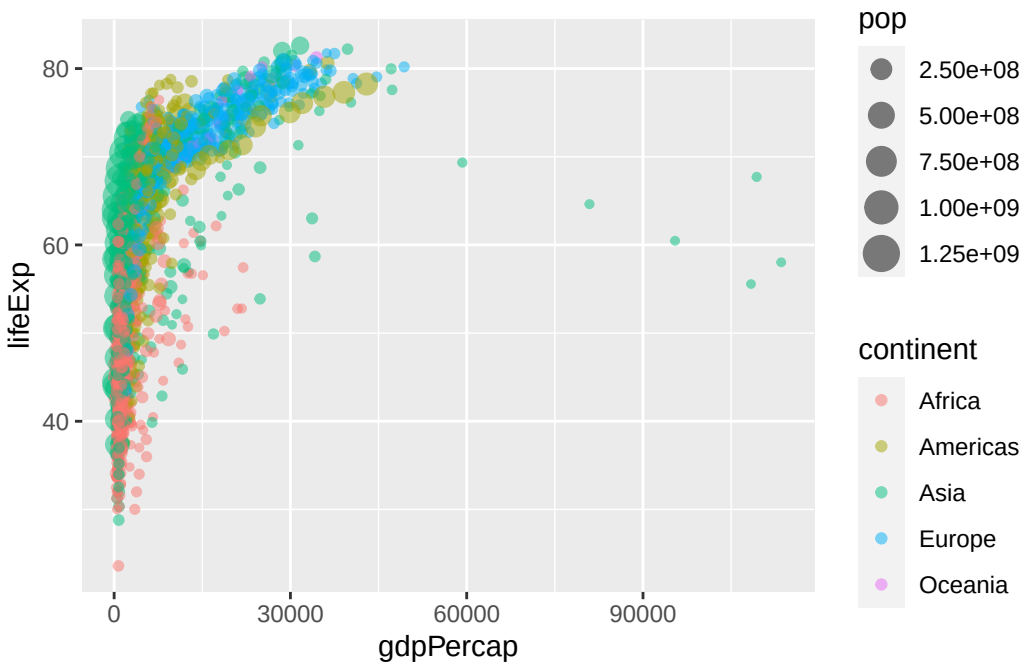
Here I read a slightly larger dataset

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

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

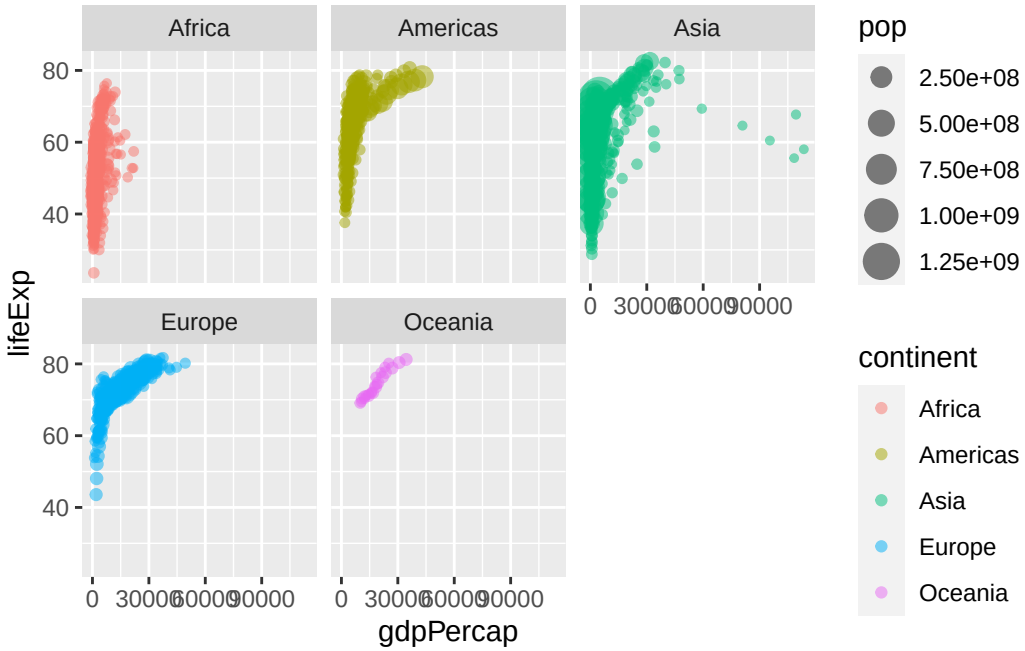
```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1952  28.801  8425333  779.4453
2 Afghanistan      Asia 1957  30.332  9240934  820.8530
3 Afghanistan      Asia 1962  31.997 10267083  853.1007
4 Afghanistan      Asia 1967  34.020 11537966  836.1971
5 Afghanistan      Asia 1972  36.088 13079460  739.9811
6 Afghanistan      Asia 1977  38.438 14880372  786.1134
```

```
ggplot(gapminder) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.5)
```



A very useful layer to add sometimes is for "faceting"

```
ggplot(gapminder) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.5) +
  facet_wrap(~continent)
```


Africa
Americas
Asia
Europe
Oceania
lifeExp
80
60
40
0
30000
60000
90000
gdpPercap
pop
2.50e+08
5.00e+08
7.50e+08
1.00e+09
1.25e+09
continent
Africa
Americas
Asia
Europe
Oceania