Class 5: Data Viz with ggplot

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#Intro to ggplot

There are many graphic systems in R(ways to make plots and figures). These include "base" R plots. Today we will focus on the **ggplot2** package.

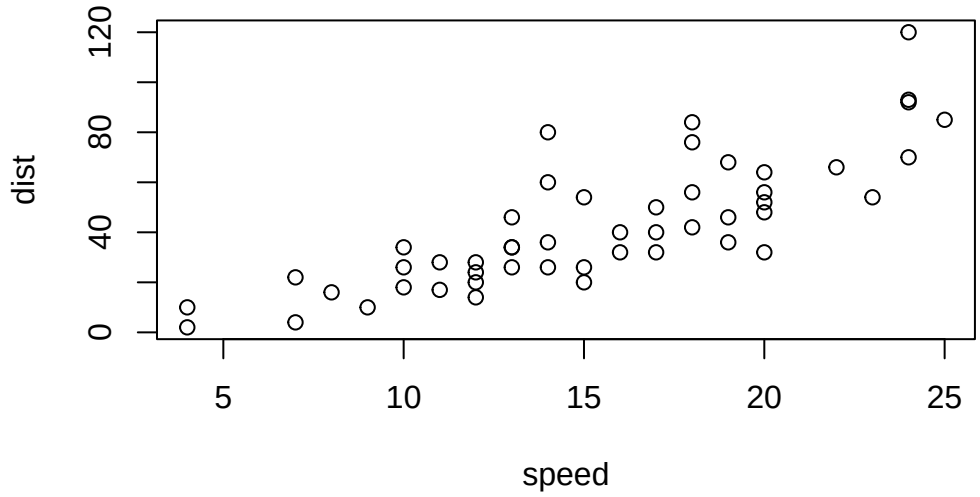
Let's start with a plot of a simple in-built dataset called `cars`

```
cars
```

```
   speed dist
1      4    2
2      4   10
3      7    4
4      7   22
5      8   16
6      9   10
7     10   18
8     10   26
9     10   34
10    11   17
11    11   28
12    12   14
13    12   20
14    12   24
15    12   28
16    13   26
17    13   34
18    13   34
19    13   46
20    14   26
21    14   36
```

```
22    14   60
23    14   80
24    15   20
25    15   26
26    15   54
27    16   32
28    16   40
29    17   32
30    17   40
31    17   50
32    18   42
33    18   56
34    18   76
35    18   84
36    19   36
37    19   46
38    19   68
39    20   32
40    20   48
41    20   52
42    20   56
43    20   64
44    22   66
45    23   54
46    24   70
47    24   92
48    24   93
49    24  120
50    25   85
```

```
plot(cars)
```



Let's see how we can make this figure using **ggplot**. First I need to install this package on my computer. To install any R package, I use the function `install.packages()`

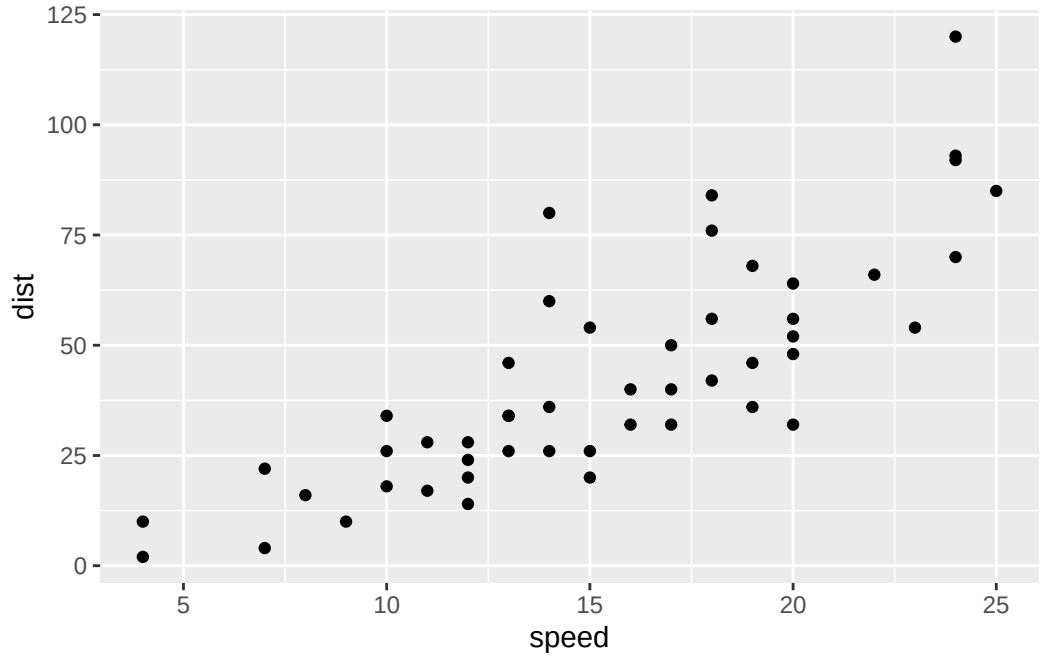
I will run 'install.packages("ggplot2") in my R console not this quarto document!

Before I can use any functions from add on packages I need to load the package from my "library()" with the `library(ggplot2)` call.

```
#install.packages("ggplot2")
library(ggplot2)
ggplot(cars)
```

All ggplot figures have at least 3 things (called layers). These include: - **data** (the input dataset I want to plot from) - **aes** (aesthetic mapping of data to my plot) - **geom**(the geom_point(), geom_line(), etc that I want to draw)

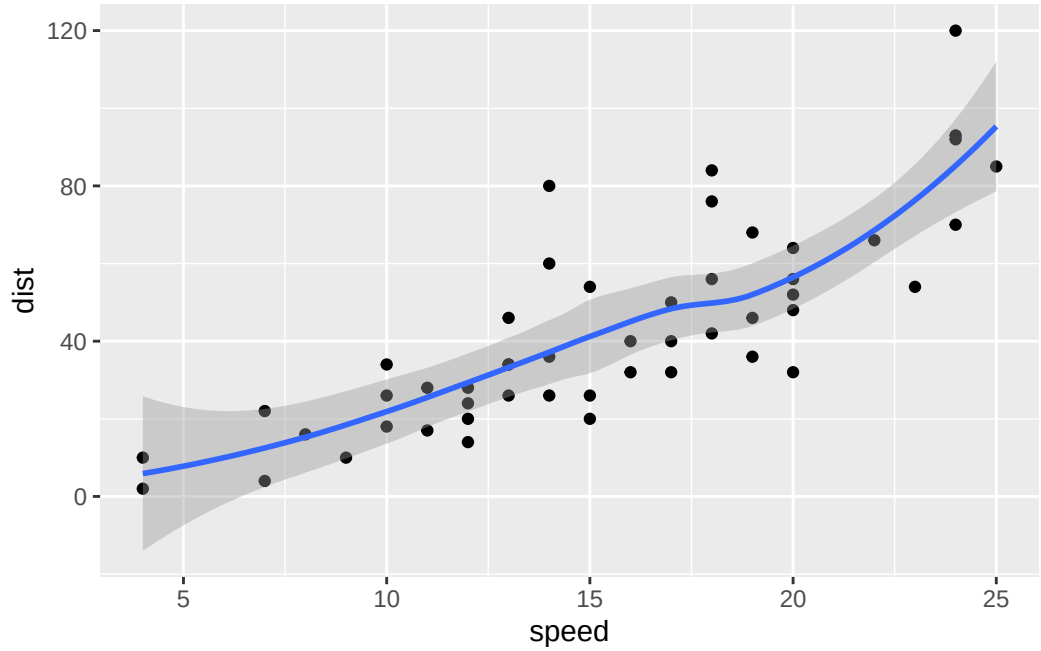
```
library(ggplot2)
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point()
```



Let's add a line to show the relationship here:

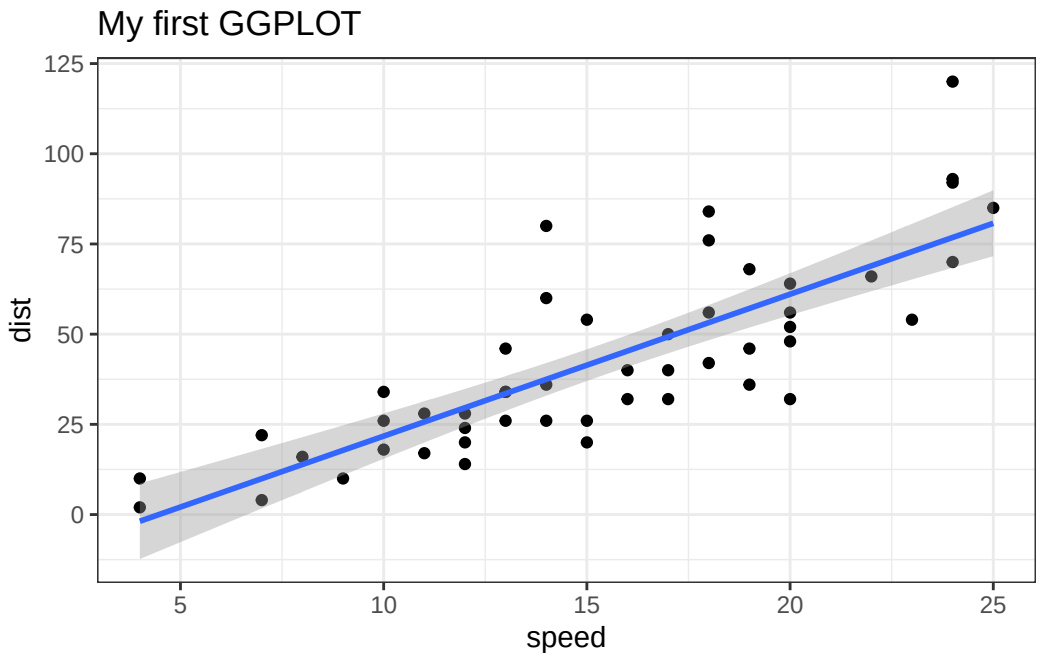
```
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point()+
  geom_smooth()
```

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




```
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point()+
  geom_smooth(method="lm")+
  theme_bw()+
  labs(title="My first GGPLOT")
```

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



Q1. Which geometric layer should be used to create scatter plots in ggplot2?

geom_point()

Part 2: Adding more plot aesthetics through aes()

The code to read the dataset

```
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
```

Q2. How many genes are in this dataset?

```
nrow(genes)
```

```
[1] 5196
```

5196 genes in the data set

> Q3. Use the colnames() function and the ncol() function on the genes data frame to find out what the column names are (we will need these later) and how many columns there are. How many columns did you find?

```
colnames(genes)
```

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

```
ncol(genes)
```

```
[1] 4
```

4 columns

> Q4. Use the table() function on the State column of this data.frame to find out how many 'up' regulated genes there are. What is your answer?

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

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

127 upregulated genes

> Q5. Using your values above and 2 significant figures. What fraction of total genes is up-regulated in this dataset?

```
round(table(genes$State)/nrow(genes),4)
```

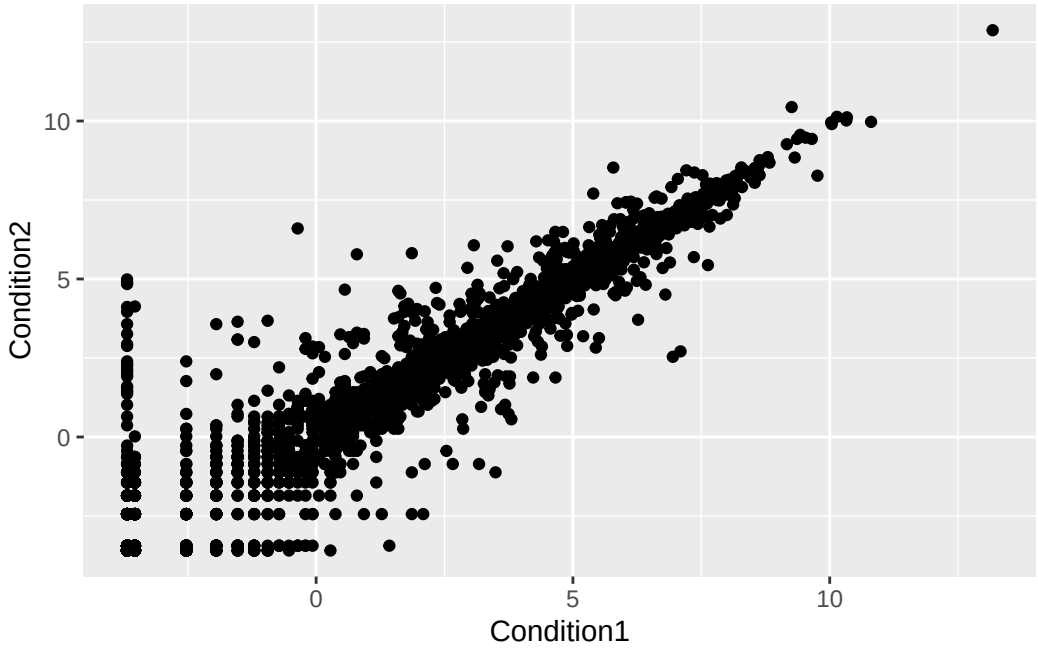
```
      down unchanging         up
    0.0139     0.9617     0.0244
```

```r
n.tot <- nrow(genes)
vals <- table(genes$State)

vals.percent <- vals/n.tot * 100
round(vals.percent, 2)
```

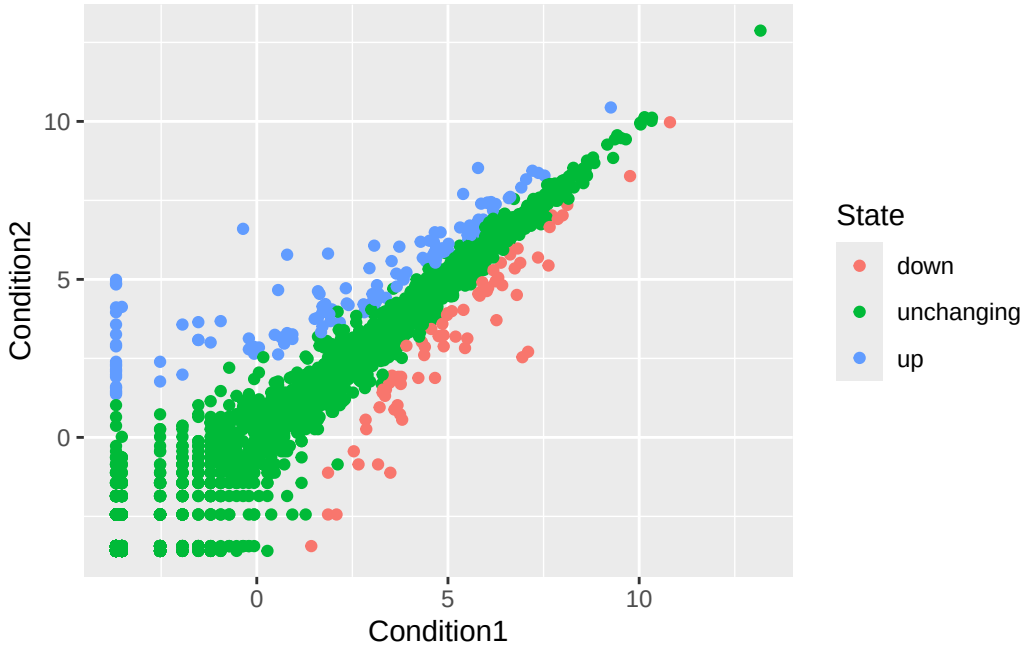
```
      down unchanging         up
      1.39      96.17       2.44
```

2.44% of genes are upregulated

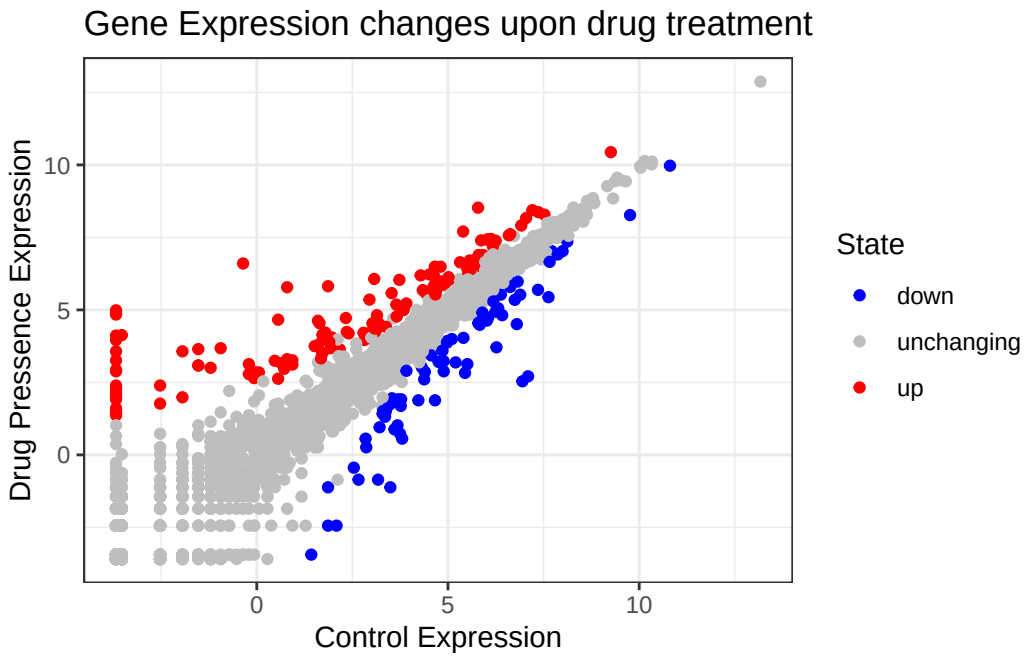
```r
ggplot(genes) +
  aes(x=Condition1, y=Condition2) +
  geom_point()
```



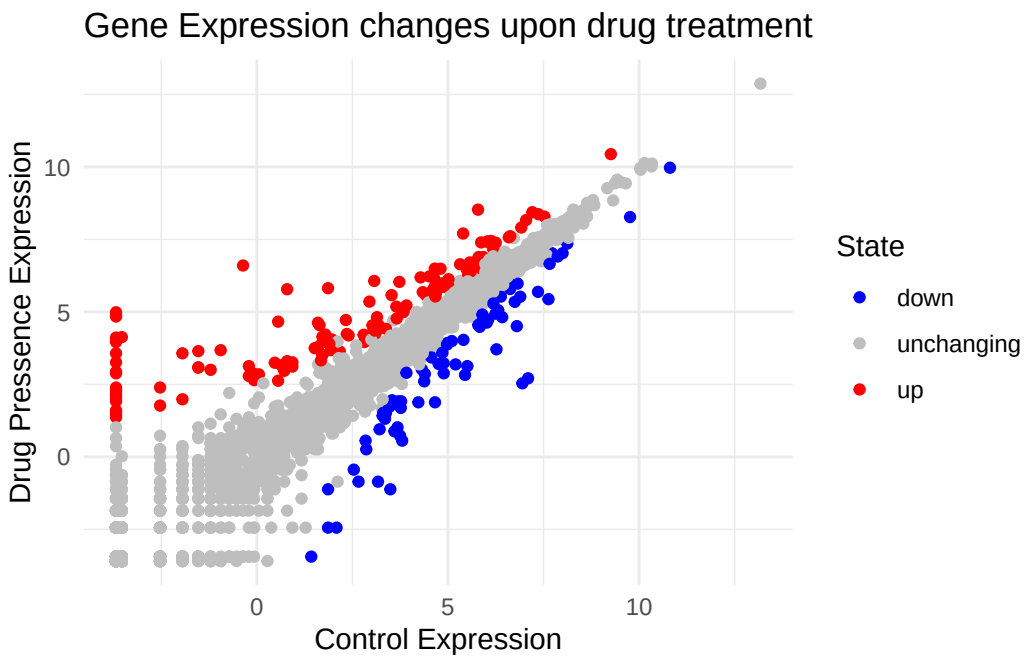

```r
ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()
```




```
ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()+
  theme_bw()+
  labs(title="Gene Expression changes upon drug treatment", x="Control Expression", y="Drug
  scale_color_manual(values=c("blue","grey","red"))
```



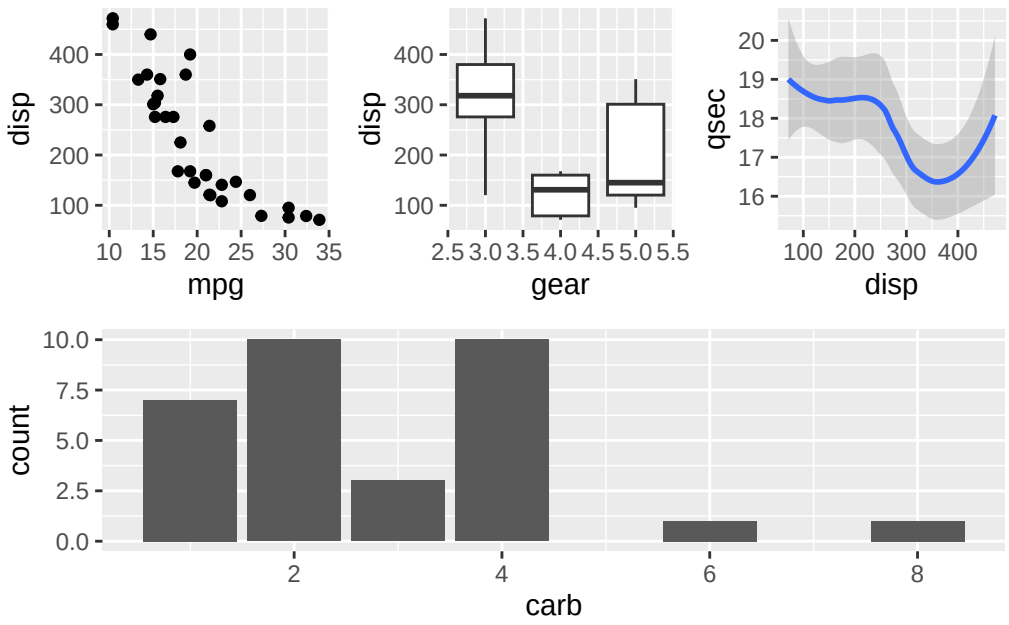

```
p <-ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()+
  theme_bw()+
  labs(title="Gene Expression changes upon drug treatment", x="Control Expression", y="Drug
  scale_color_manual(values=c("blue","grey","red"))

p + theme_minimal()
```



Part 3:Combining plots

```
#install.packages("patchwork")
library(patchwork)

# Setup some example plots
p1 <- ggplot(mtcars) + geom_point(aes(mpg, disp))
p2 <- ggplot(mtcars) + geom_boxplot(aes(gear, disp, group = gear))
p3 <- ggplot(mtcars) + geom_smooth(aes(disp, qsec))
p4 <- ggplot(mtcars) + geom_bar(aes(carb))

# Use patchwork to combine them here:
(p1 | p2 | p3) /
      p4
```

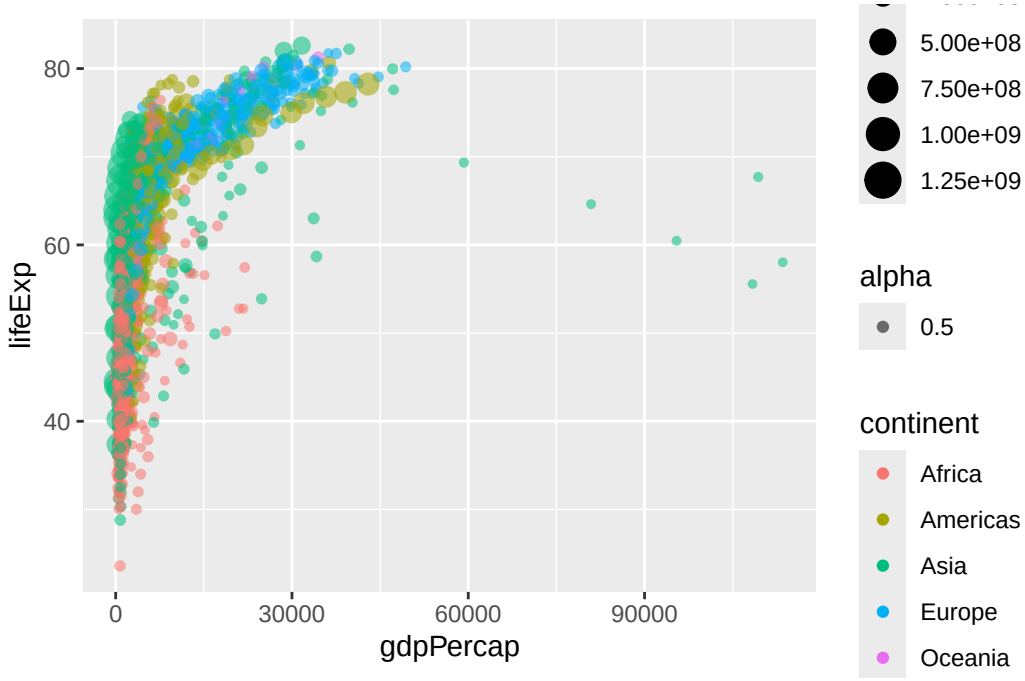
```
`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



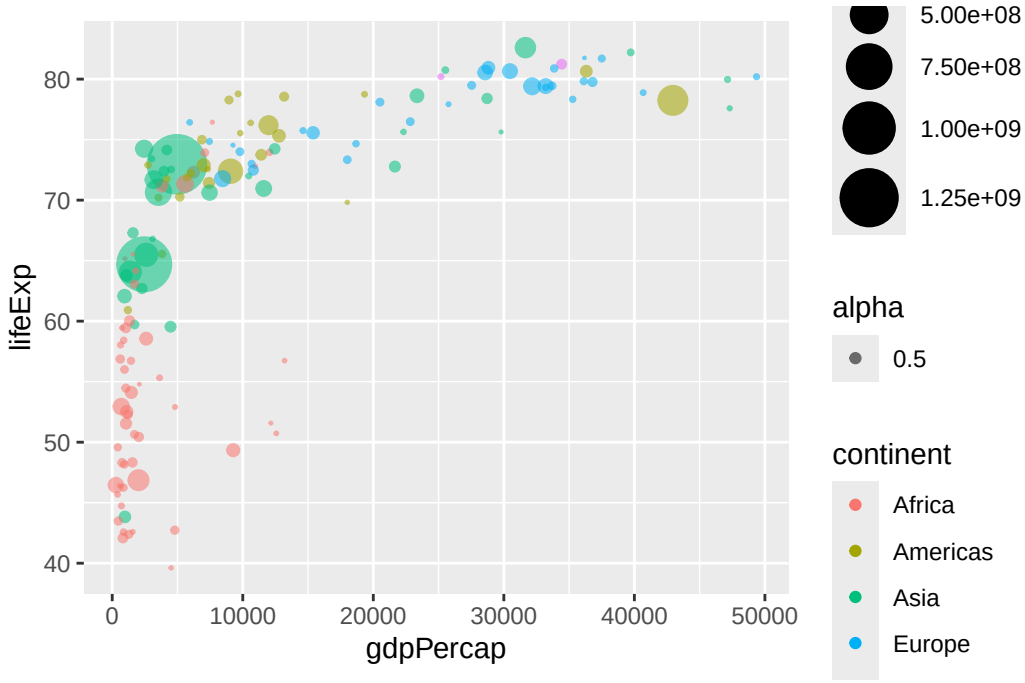

```
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.tsv

gapminder <- read.delim(url)
#install.packages("dplyr")
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

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




```
gapminder_2007 <- gapminder %>% filter(year==2007)
ggplot(gapminder_2007) +
  geom_point()+
  aes(x = gdpPercap, y = lifeExp, color= continent, size = pop, alpha=0.5) +
  scale_size_area(max_size = 10)
```


lifeExp
80
70
60
50
40
0
10000
20000
30000
40000
50000
gdpPercap
5.00e+08
7.50e+08
1.00e+09
1.25e+09
alpha
0.5
continent
Africa
Americas
Asia
Europe