Class 05: Data Visualization with GGPLOT

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Intro to ggplot

There are many graphics systems in R (ways to make plots and figures). These include “base” R plots. Today we will focus mostly on the **ggplot** package.

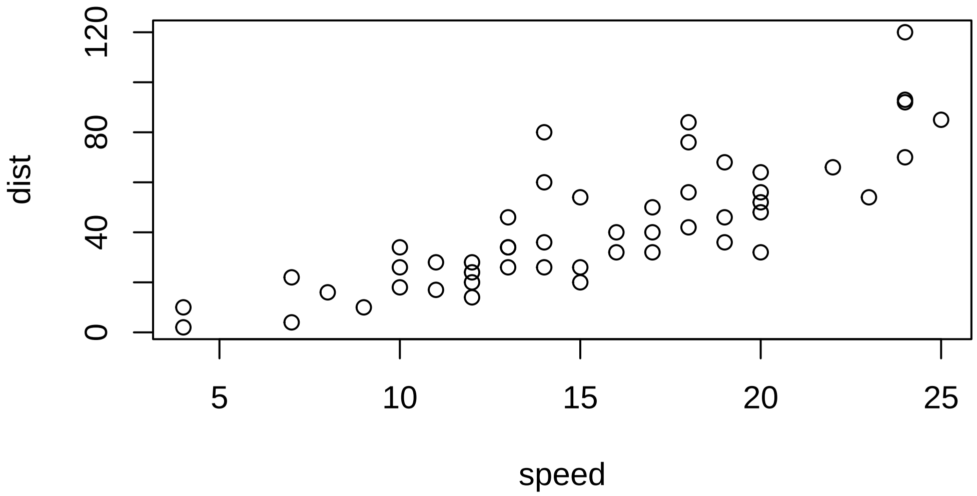
Lets start with a plot of a simple in-built dataset called `cars`.

```
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
```

```r
plot(cars)
```

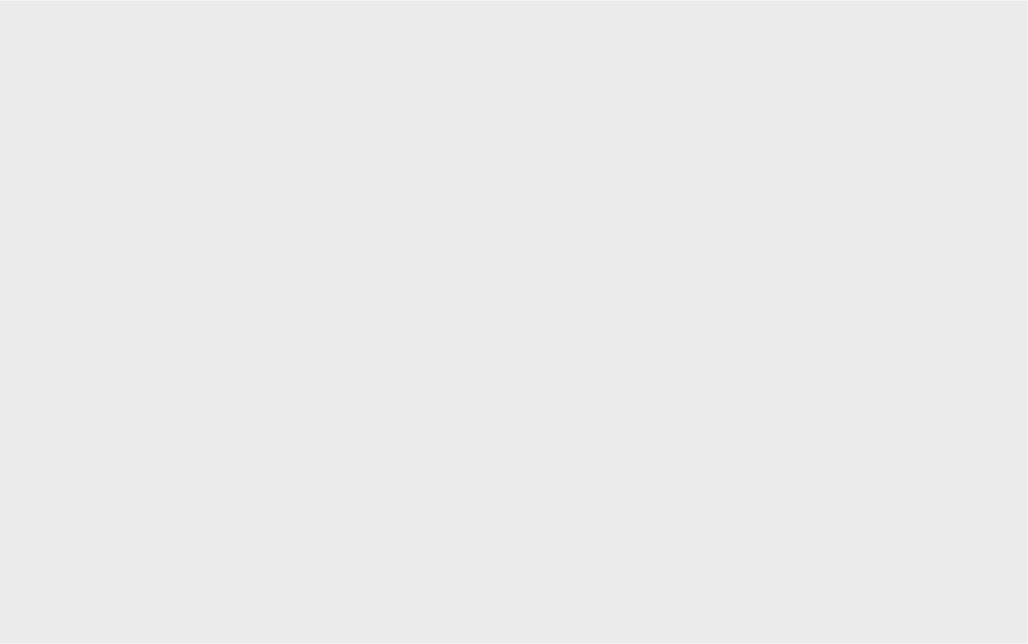


Let’s see how we can make this figure using **ggplot**. First I need to install this package on my computer. To install any R package I use the function `install.packages()`.

> 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.

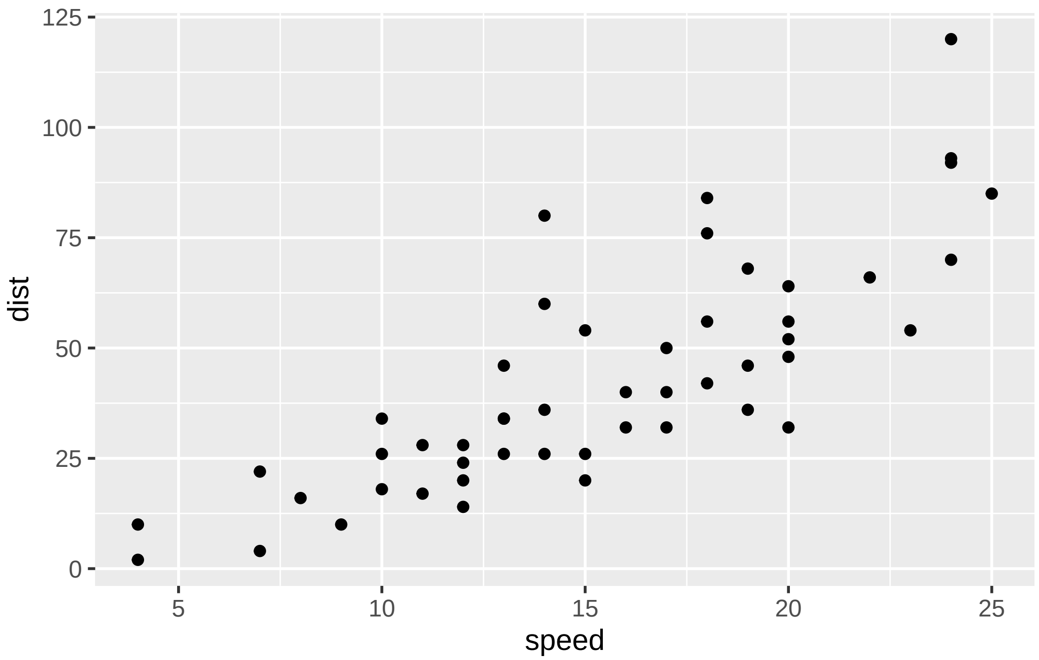
```r
library(ggplot2)
ggplot(cars)
```



All ggplot figures have at least 3 things (called layers). These include:

- **data** (the input dataset I want to plot from)
- **aes** (the aesthetic mapping of the data to my plot)
- **geoms** (the geom_point(), geom_line(), etc. that I want to draw).

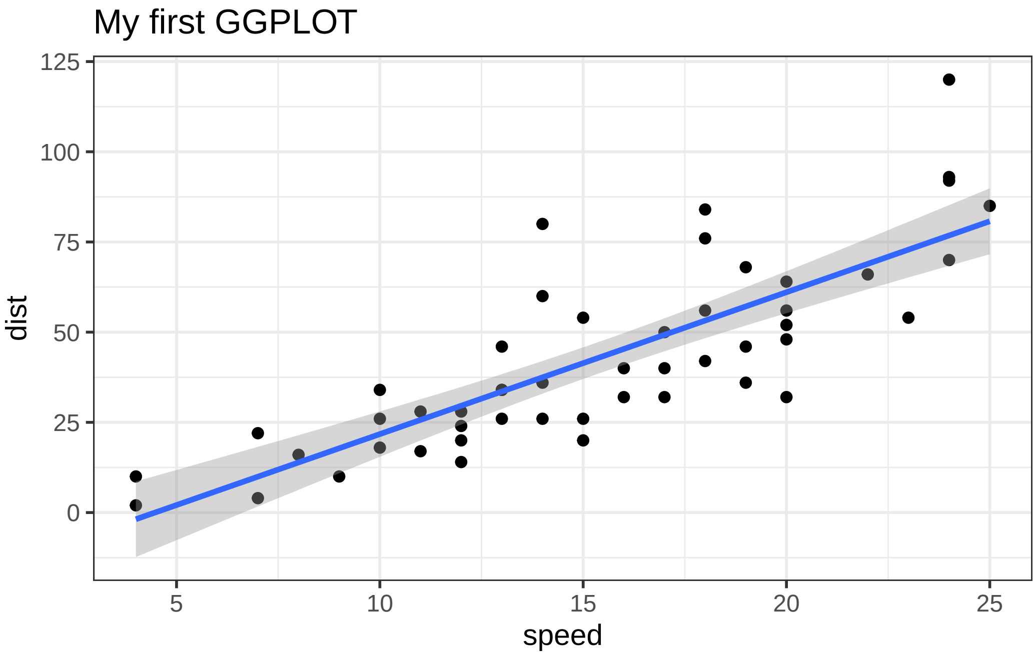
```r
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point()
```



Lets add a line to show the relationship here:

```r
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()

Gene expression figure

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
```

How many genes are in this dataset?

```
nrow(genes)
```

```
[1] 5196
```

How many columns did you find?

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

```

      down unchanging         up 
        72       4997        127 
```

Q. 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)
```

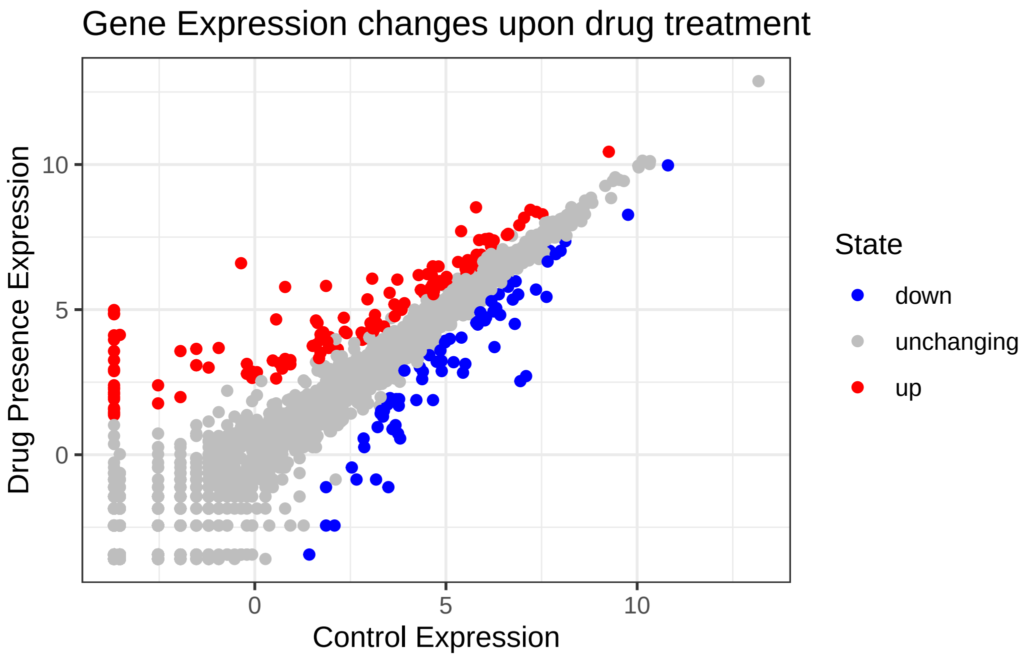
```
numeric(0)
```

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

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

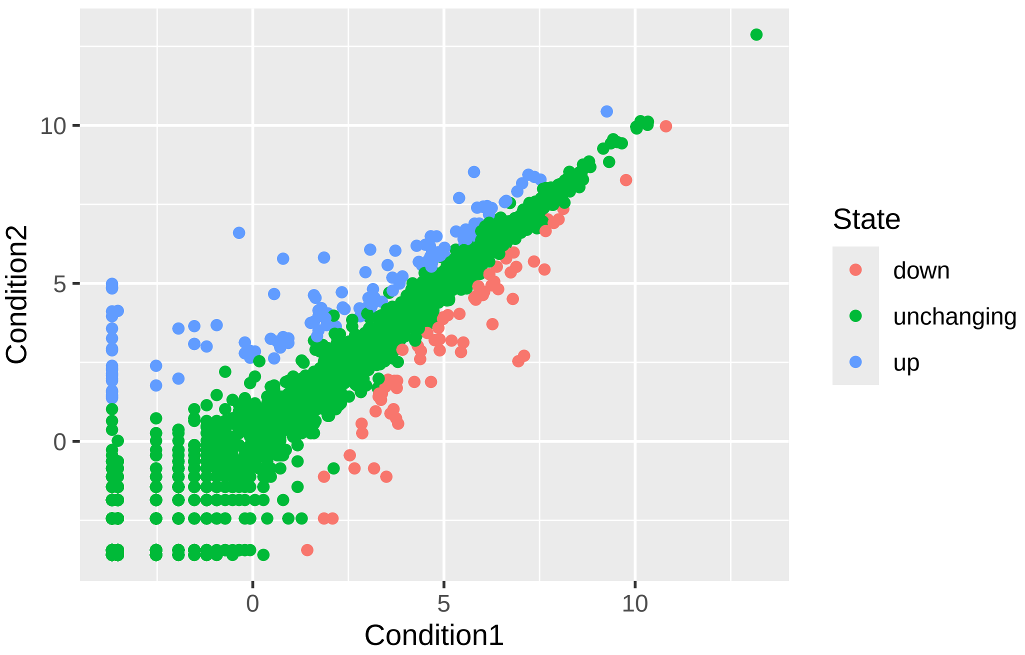
```

      down unchanging         up 
      1.39      96.17       2.44 
```

A first plot of this dataset

```
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 Presence Expression") +
scale_colour_manual( values=c("blue","gray","red") )
```

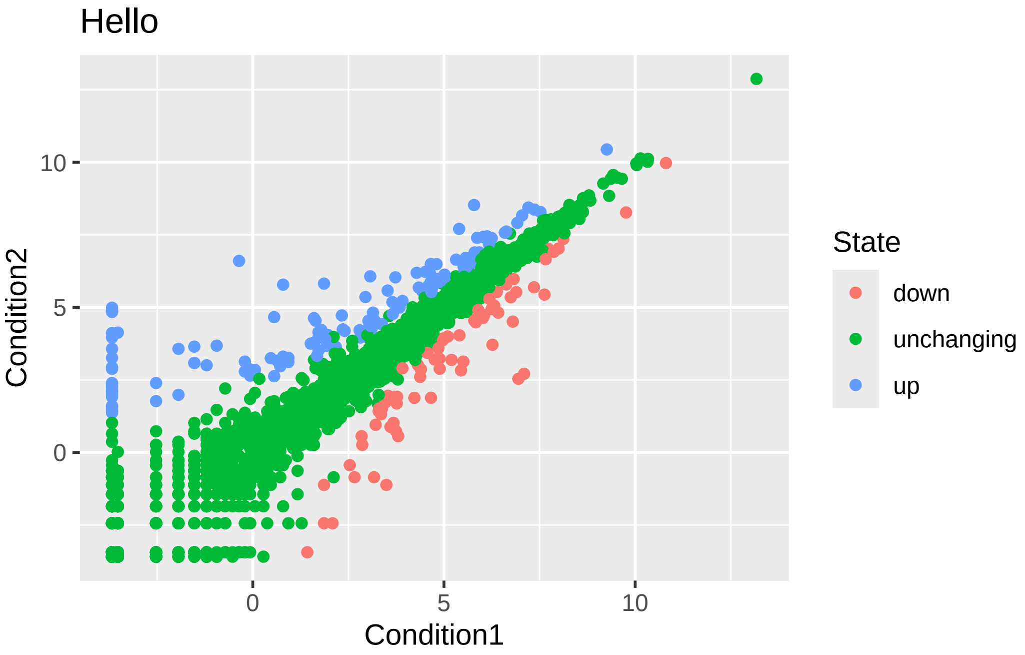


```
p <- ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point()

p
```

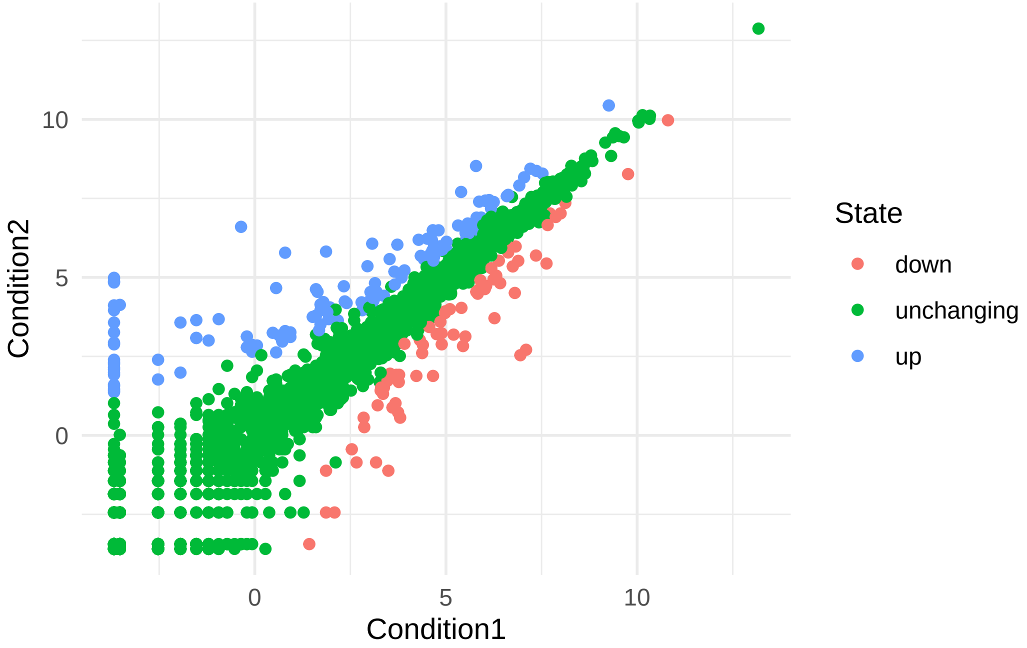


```
#p + scale_colour_manual( values=c("blue","gray","red") )
```

```
p + labs( title="Hello")
```



```
p + theme_minimal()
```



Exploring the gapminder dataset

The gapminder dataset contains economic and demographic data about various countries since 1952.

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

gapminder <- read.delim(url)

head(gapminder)
```

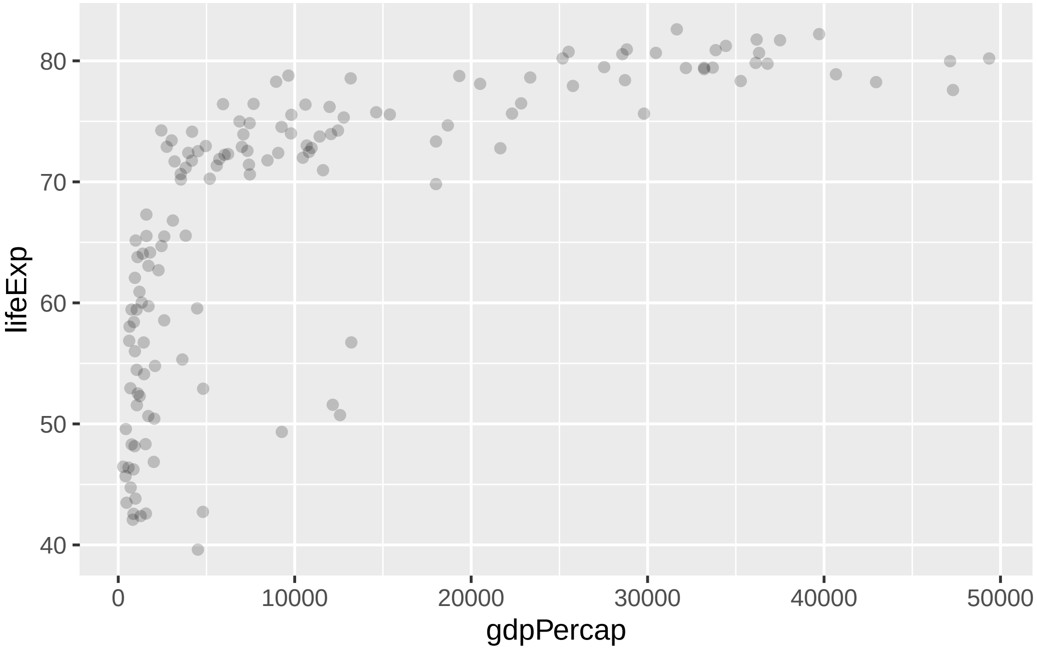
```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1952  28.801  8425333  779.4453
2 Afghanistan      Asia 1957  30.332  9240934  820.8530
3 Afghanistan      Asia 1962  31.997 10267083  853.1007
4 Afghanistan      Asia 1967  34.020 11537966  836.1971
5 Afghanistan   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

```
# install.packages("dplyr")  ## un-comment to install if needed
library(dplyr)
```

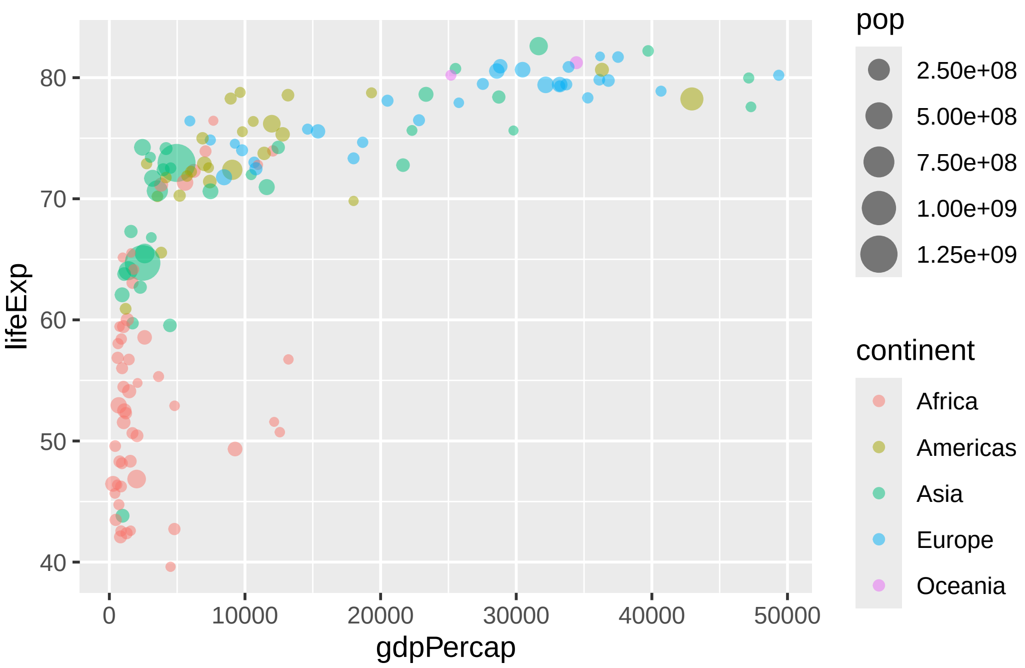
```

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
```

```
gapminder_2007 <- gapminder %>% filter(year==2007)
```

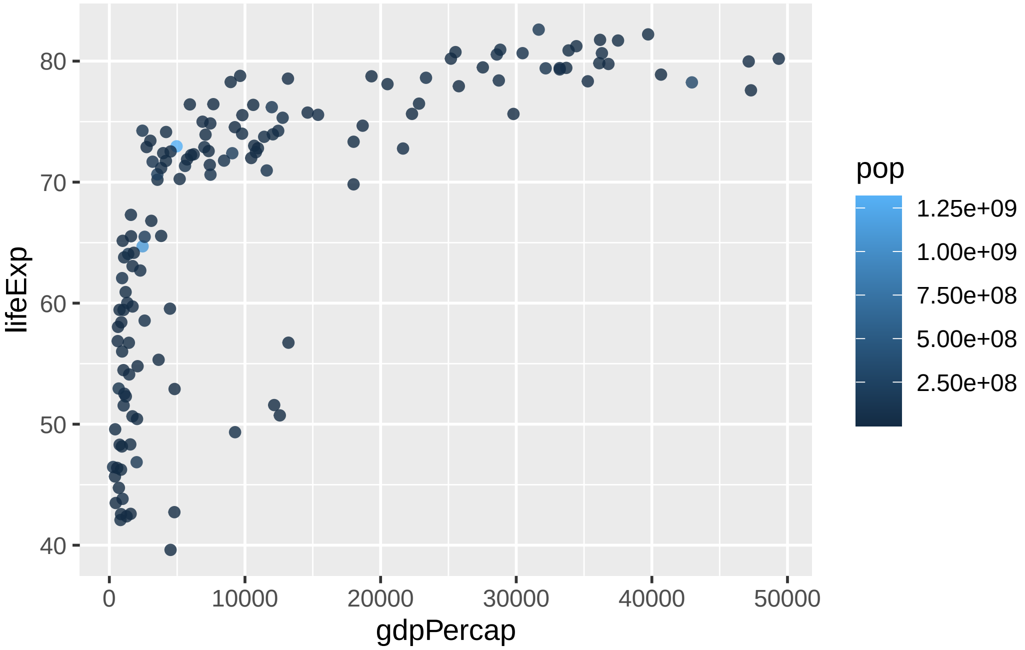
```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point(alpha=0.2)
```



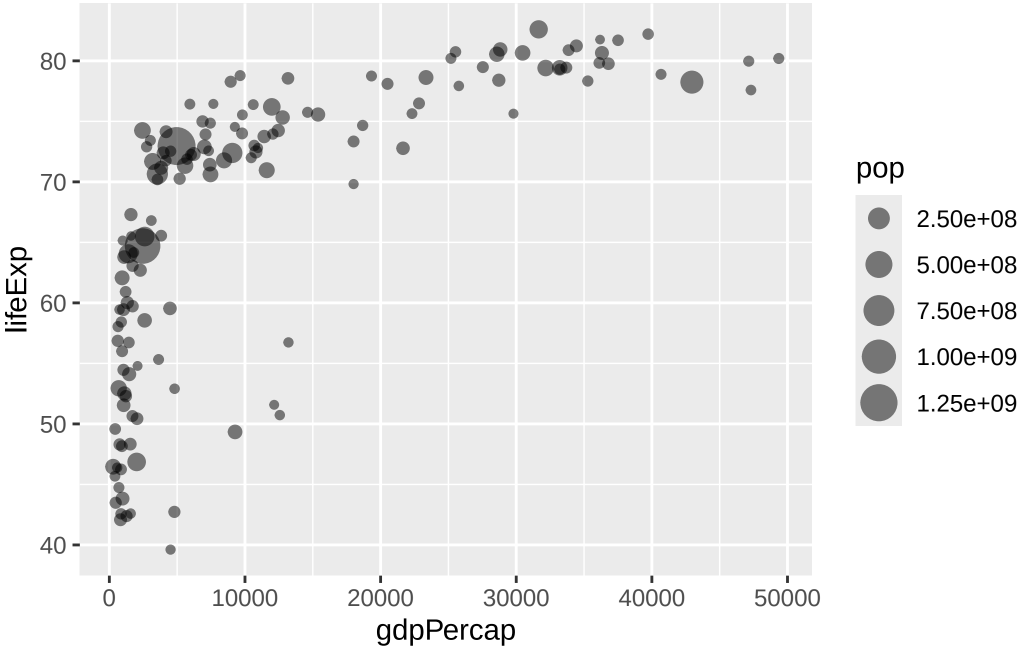
```r
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, color=continent, size=pop) +
  geom_point(alpha=0.5)
```



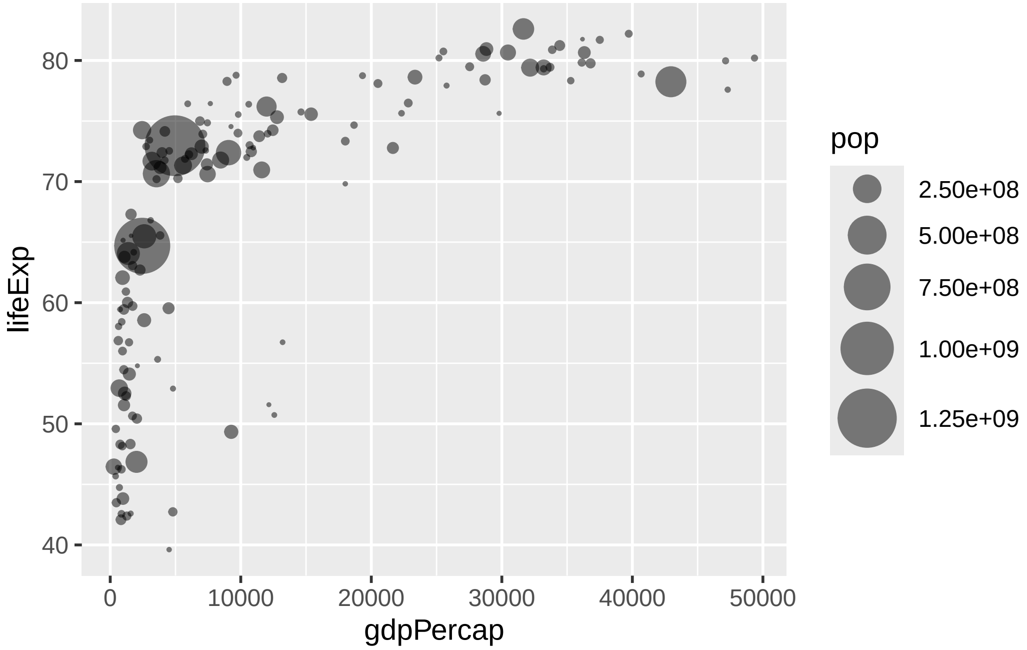
```r
ggplot(gapminder_2007) +
  aes(x = gdpPercap, y = lifeExp, color = pop) +
  geom_point(alpha=0.8)
```



```
ggplot(gapminder_2007) +
  aes(x = gdpPercap, y = lifeExp, size = pop) +
  geom_point(alpha=0.5)
```

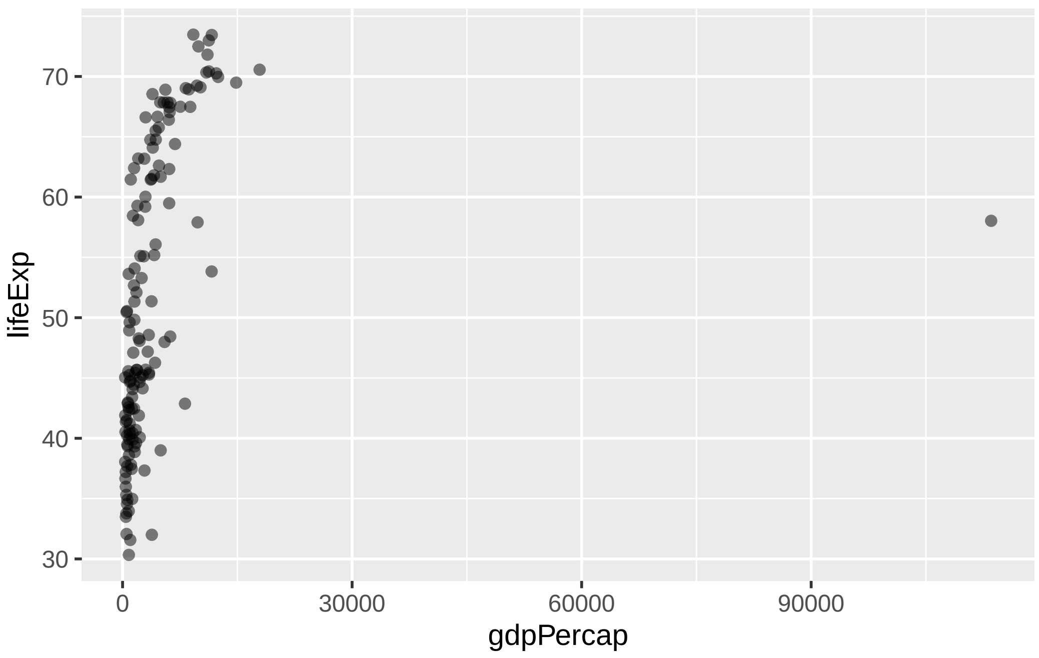


```
ggplot(gapminder_2007) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 size = pop), alpha=0.5) +
  scale_size_area(max_size = 10)
```

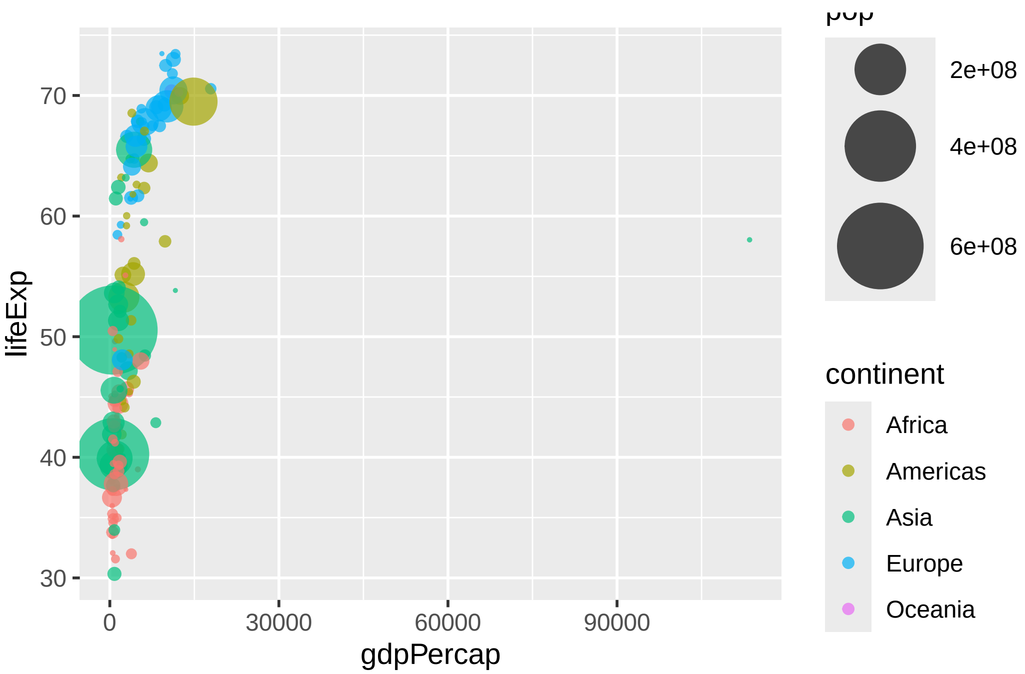


```
# install.packages("dplyr")  ## un-comment to install if needed
library(dplyr)

gapminder_1957 <- gapminder %>% filter(year==1957)
```

```
ggplot(gapminder_1957) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point(alpha=0.5)
```



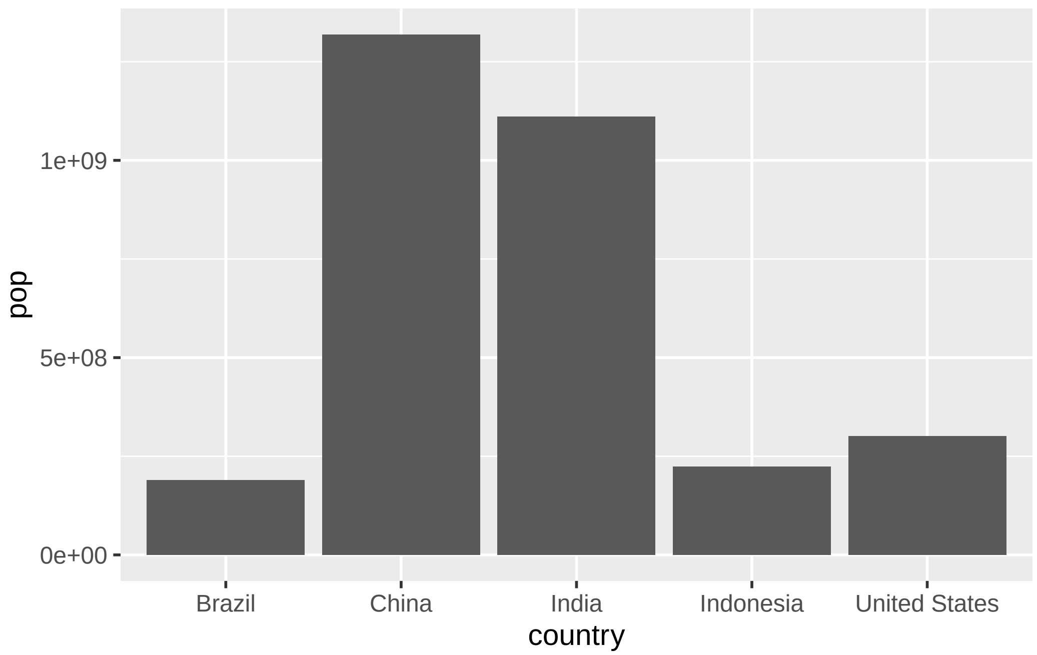
```
ggplot(gapminder_1957) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 size = pop, color = continent), alpha=0.7) +
  scale_size_area(max_size = 15)
```



```r
gapminder_top5 <- gapminder %>%
  filter(year==2007) %>%
  arrange(desc(pop)) %>%
  top_n(5, pop)

gapminder_top5
```

```
        country continent year lifeExp        pop gdpPercap
1         China      Asia 2007  72.961 1318683096  4959.115
2         India      Asia 2007  64.698 1110396331  2452.210
3 United States  Americas 2007  78.242  301139947 42951.653
4     Indonesia      Asia 2007  70.650  223547000  3540.652
5        Brazil  Americas 2007  72.390  190010647  9065.801
```

```r
ggplot(gapminder_top5) +
  geom_col(aes(x = country, y = pop))
```


pop
1e+09
5e+08
0e+00
Brazil
China
India
Indonesia
United States
country