# Class 5: Data Visualization with ggplot

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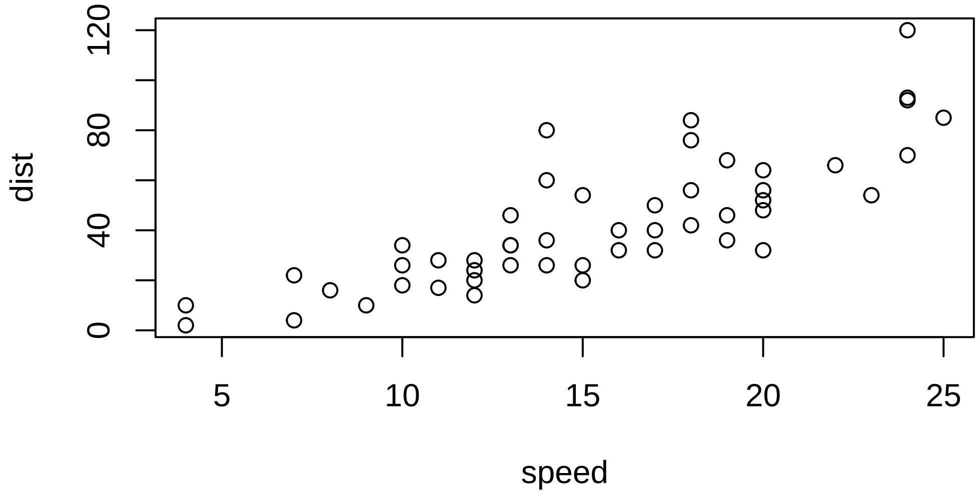
Today we will have our first play with the **ggplot2** package - one of the most popular graphics package son the planet.

There are amny plotting systems in R. These include so called *"base"* plotting/graphics.

```
plot(cars)
```



Base plot is generally rather short code and somewhat dull plots ~ but it is always there for you and is fast for big data sets.

If I want to use **ggplot2** it takes some more work.

```
# ggplot(cars)
```

I need to install the package first to my computer. To do this I can use the function `install.packages(ggplot2)`

Every time I want to use a pacakage I need to load it up with a `library()` call.

```
# install.packages(ggplot2)
library(ggplot2)
```

Now finally I can use ggplot

```
ggplot(cars)
```

Every ggplot has at least 3 things:

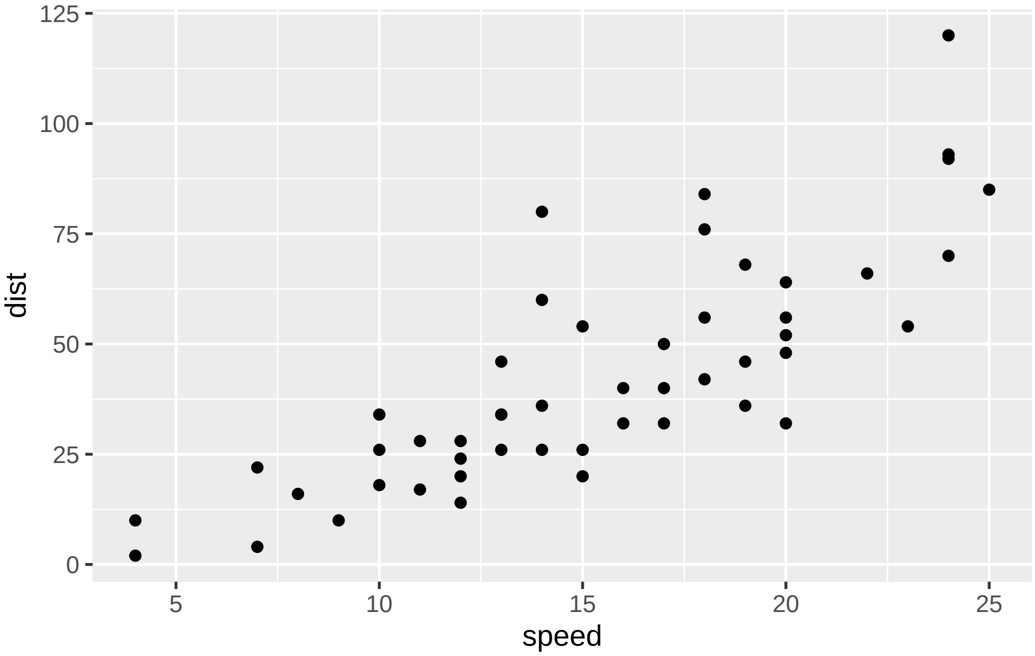
- **data** (the data.frame with the data you want to plot)
- **aes** (the aesthetic mapping of the data to the plot)

- **geom** (how do you want the plot to look, points, lines, etc.)

```
head(cars)
```

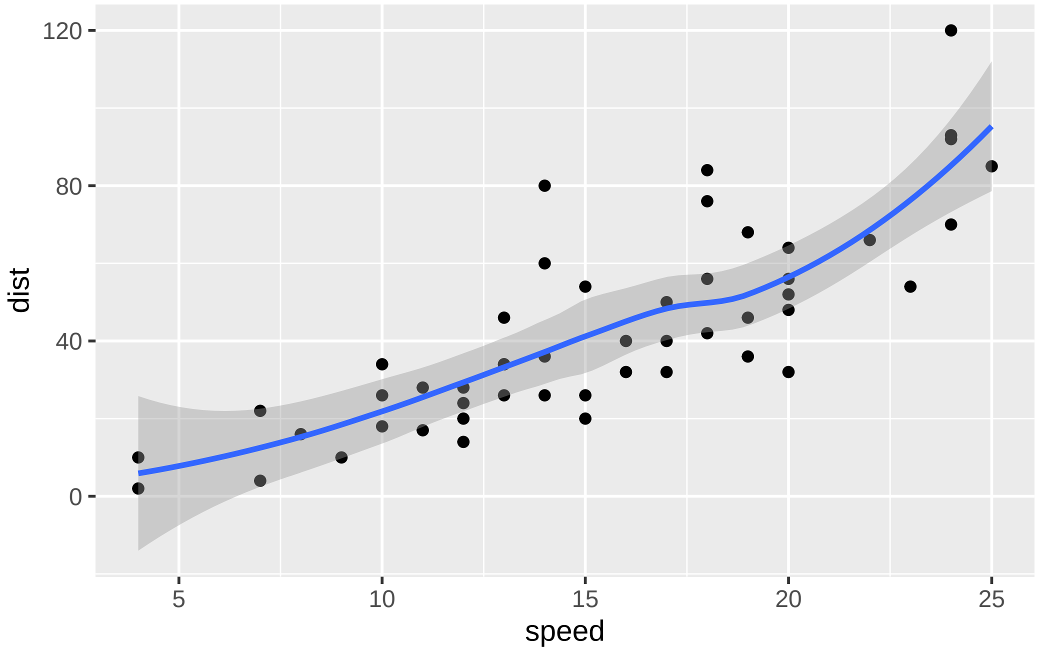
```
  speed dist
1     4    2
2     4   10
3     7    4
4     7   22
5     8   16
6     9   10
```

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



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

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

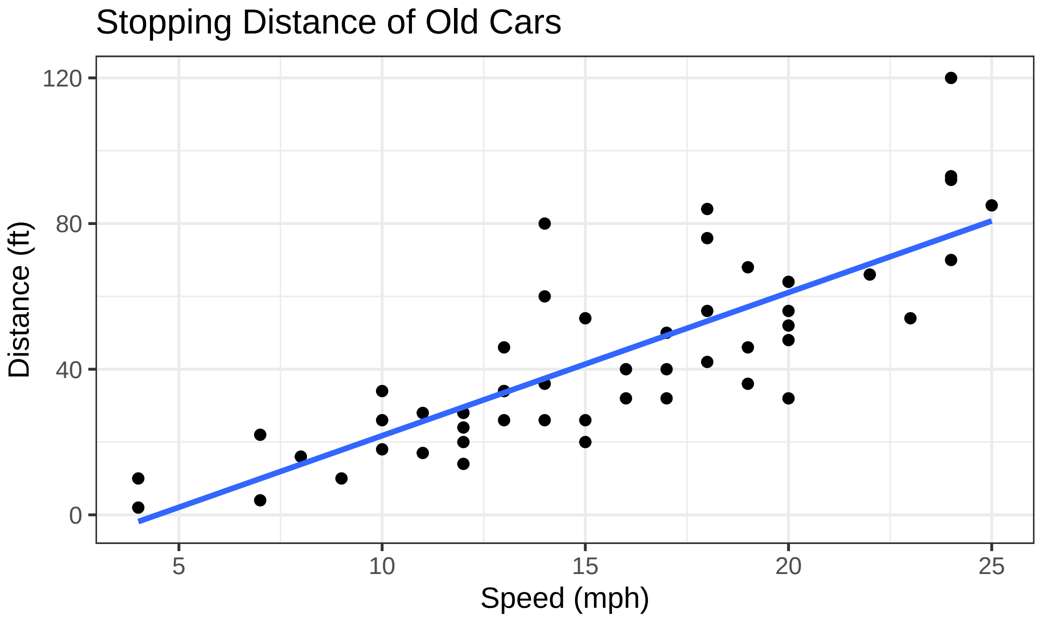


I want a liner model and no standard error bounds shown.

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

```r
bp + geom_smooth(se = FALSE, method = "lm") +
  labs(title = "Stopping Distance of Old Cars",
       x = "Speed (mph)", y = "Distance (ft)",
       caption = "From the 'cars' dataset") + theme_bw()
```

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



From the 'cars' dataset

### A more complicated scatter plot

Here we make a plot of gene expression data:

```
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
```

```
nrow(genes)
```

```
[1] 5196
```

```r
colnames(genes)
```

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

```r
ncol(genes)
```

```
[1] 4
```

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

```

      down unchanging         up 
        72       4997        127 
```

```r
round(table(genes$State)[3]/ nrow(genes) * 100, 2)
```

```
  up 
2.44 
```

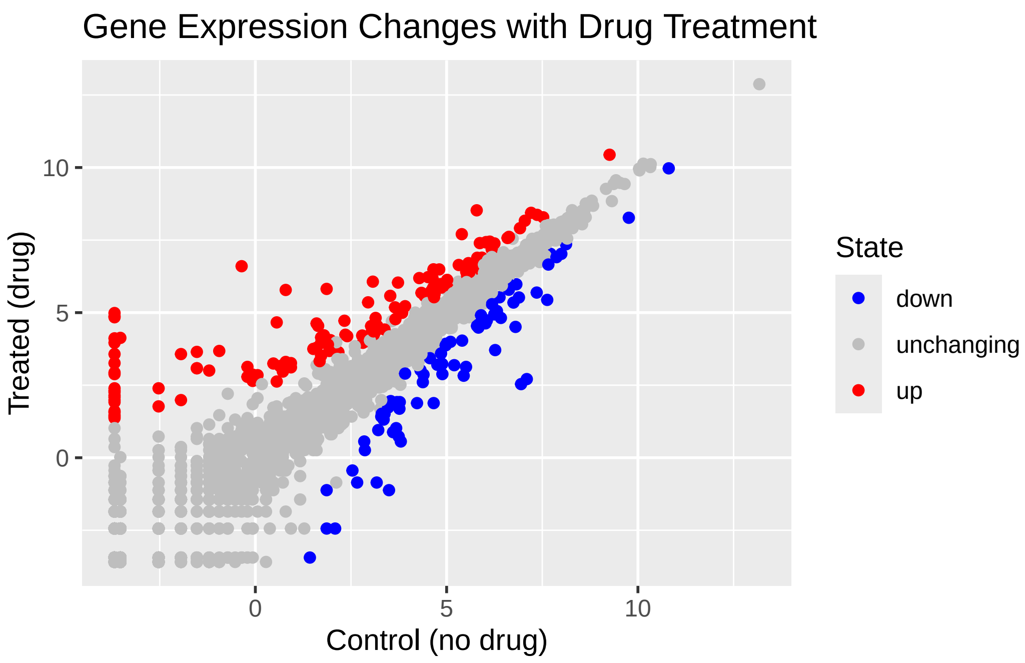
```r
n.gene <- nrow(genes)
n.up <- sum(genes$State == "up")

up.percent <- n.up/n.gene * 100
round(up.percent, 2)
```

```
[1] 2.44
```

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

Change the colors and the labels that were provided for the plot.

```r
t + scale_colour_manual(values = c("blue", "grey", "red")) +
  labs(title = "Gene Expression Changes with Drug Treatment",
       x= "Control (no drug)", y= "Treated (drug)")
```



### Exploring the gapmider dataset

Here we will load up the gapmider dataset to get practice with different aes mappings.

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

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

> Q. How many entries rows are in this dataset?

```r
nrow(gapmider)
```

```
[1] 1704
```

> Q. How many columns are in this dataset?

```r
ncol(gapmider)
```

```
[1] 6
```

```r
dim(gapmider)
```

```
[1] 1704    6
```

```r
head(gapmider)
```

```
      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
```

```r
table(gapmider$year)
```

```
1952 1957 1962 1967 1972 1977 1982 1987 1992 1997 2002 2007 
 142  142  142  142  142  142  142  142  142  142  142  142 
```

> Q. How many continents?

```r
table(gapmider$continent)
```

```
  Africa Americas     Asia   Europe  Oceania 
     624      300      396      360       24 
```

I could use the `unique()` function…

```r
length(unique(gapmider$continent))
```

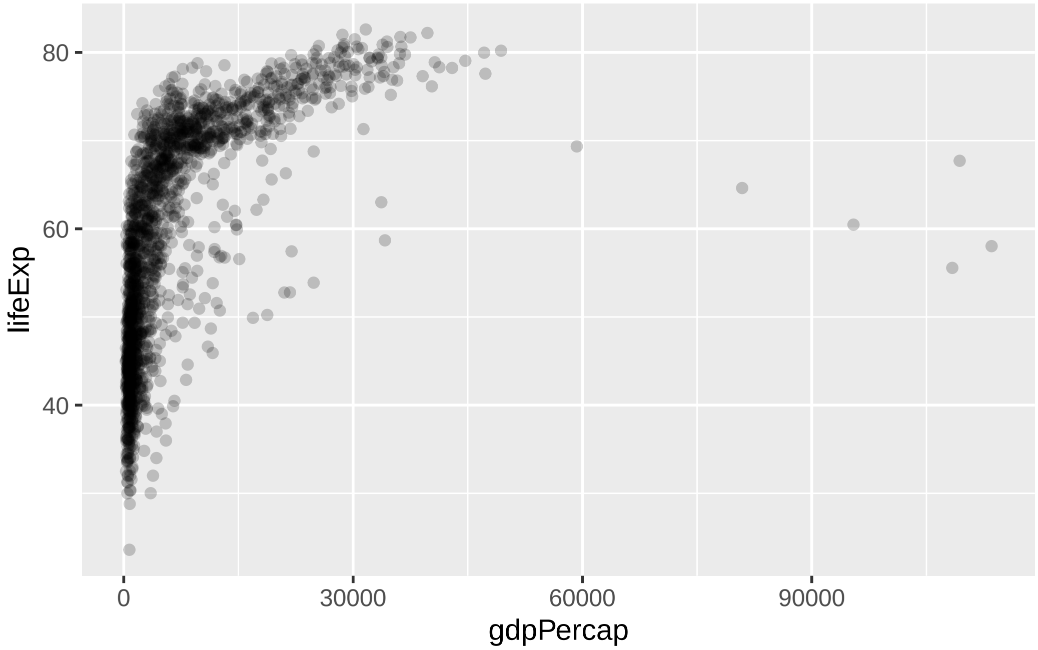
```
[1] 5
```

> Q. How many countries are there in this dataset?

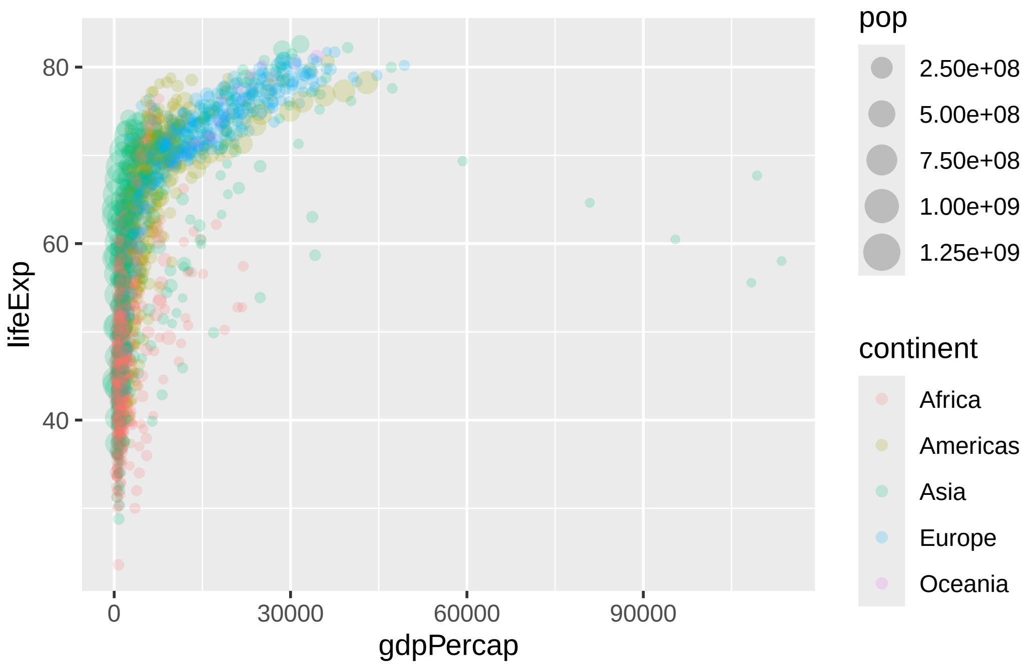
```r
# unique(gapmider$country)
length(unique(gapmider$country))
```

```
[1] 142
```

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



```
ggplot(gapmider) + aes(x = gdpPercap, y = lifeExp,
                       col = continent, size = pop) +
  geom_point(alpha = 0.2)
```



```
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
```

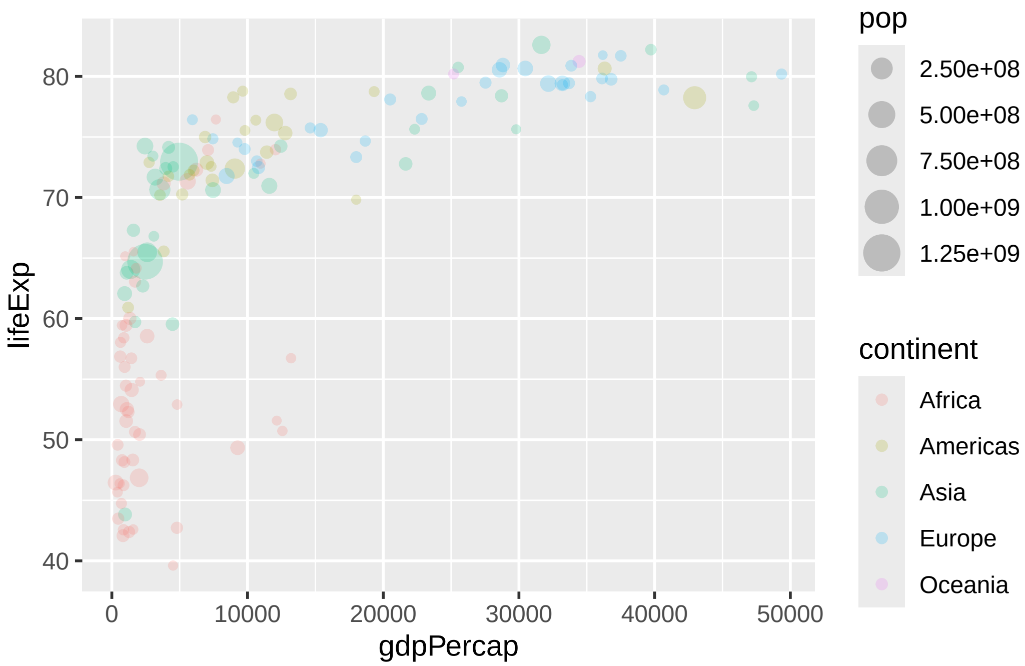
```
gapminder_2007 <- gapmider %>% filter(year==2007)

head(gapminder_2007)
```

```
      country continent year lifeExp      pop  gdpPercap
1 Afghanistan      Asia 2007  43.828 31889923   974.5803
2     Albania    Europe 2007  76.423  3600523  5937.0295
```

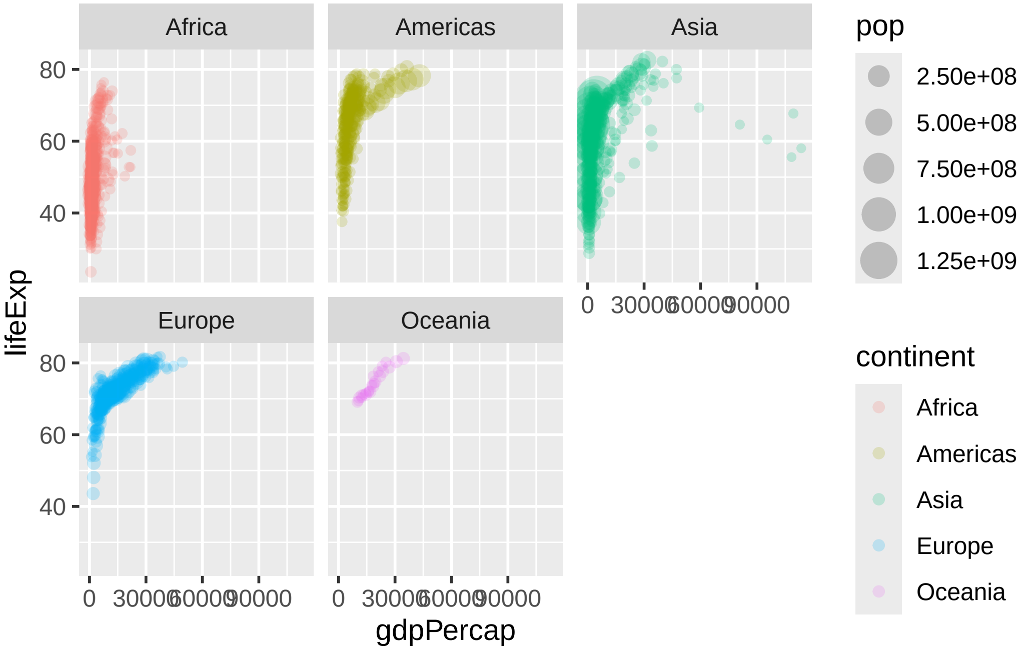
```
3     Algeria    Africa 2007  72.301 33333216  6223.3675
4      Angola    Africa 2007  42.731 12420476  4797.2313
5   Argentina  Americas 2007  75.320 40301927 12779.3796
6   Australia   Oceania 2007  81.235 20434176 34435.3674
```

Plot of 2007 with population and continent data

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



```
ggplot(gapmider) + aes(x = gdpPercap, y = lifeExp,
                       col = continent, size = pop) +
  geom_point(alpha = 0.2) + 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