Class 5: Data Visualization with ggplot

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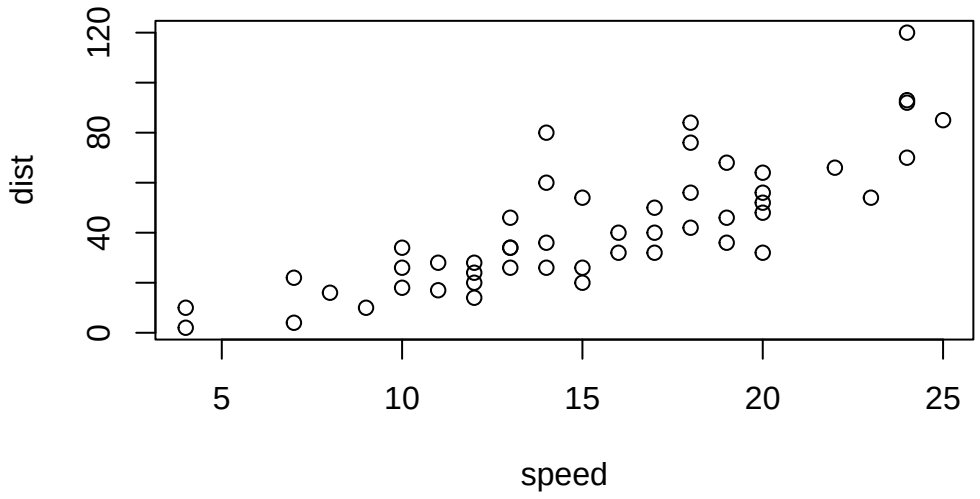
Today we will have our first play with the **ggplot2** package - one of the most popular graphics packages on the planet.

There are many 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 datasets.

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 package, I need to load it up with a `library()` call.

```
library(ggplot2)
```

Now finally I can use ggplot

```
ggplot(cars)
```

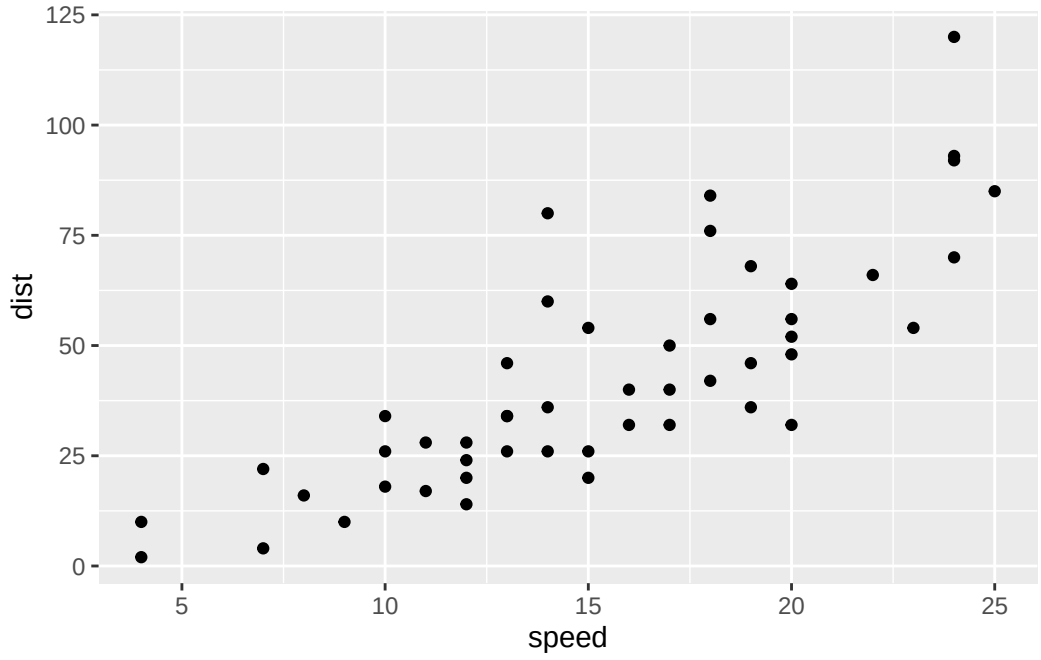

Every ggplot has at least 3 things:

- **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, columns, etc.)

```
head(cars)
```

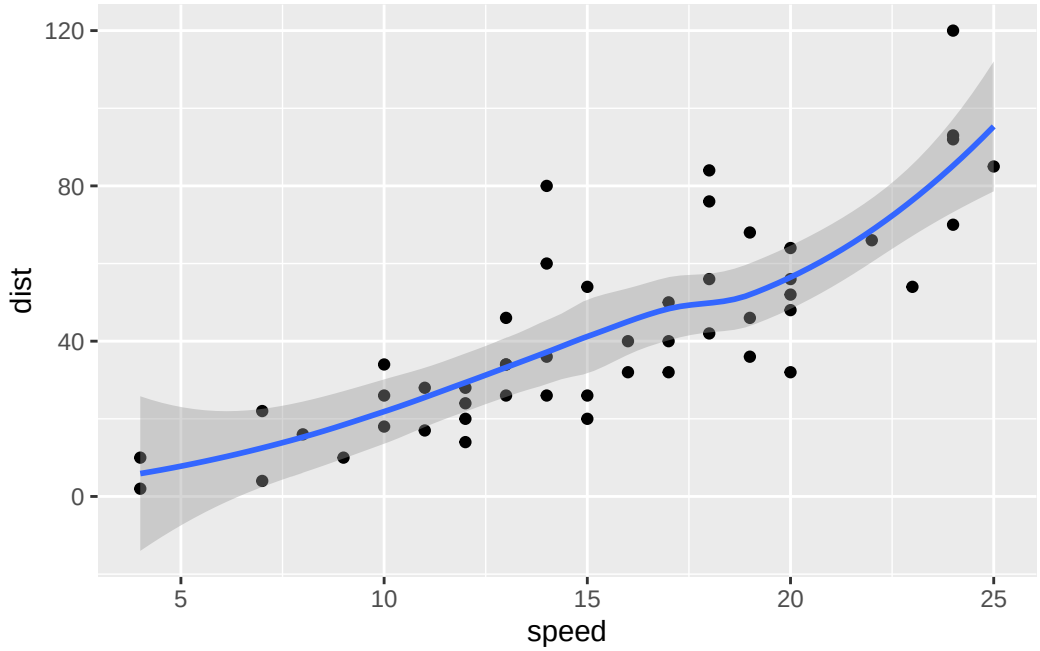
```
  speed dist
1     4    2
2     4   10
3     7    4
4     7   22
5     8   16
6     9   10
```

```
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'
```

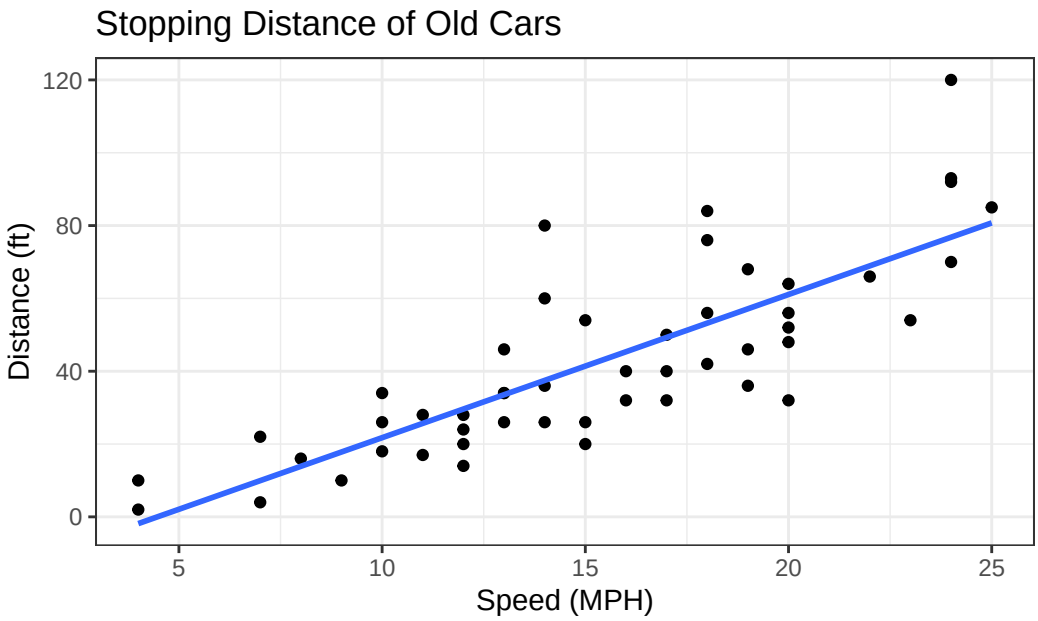


I want a linear model and no standard error bounds on my plot. I also want nicer axis labels, a title, etc.

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

```
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'
```



A more compicated 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
ncol(genes)
```

```
[1] 4
```

```r
colnames(genes)
```

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

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

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

```r
sum(genes$State == "up")
```

```
[1] 127
```

```r
round(sum(genes$State == "up") / nrow(genes) *100,4)
```

```
[1] 2.4442
```

```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
```

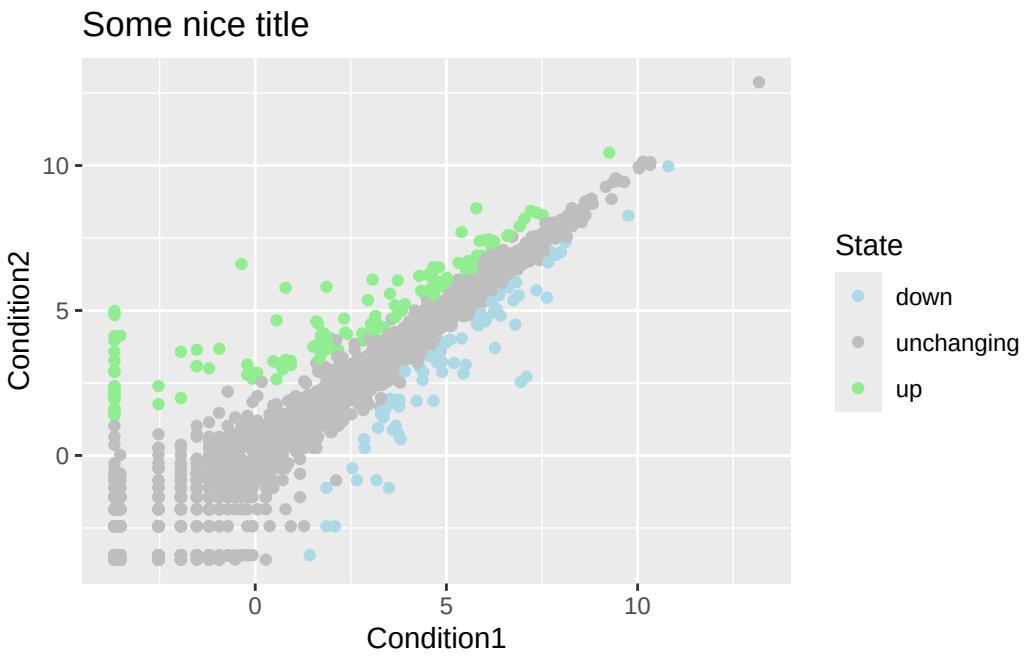
```r
head(genes, 2)
```

```
   Gene Condition1 Condition2      State
1 A4GNT  -3.680861  -3.440135 unchanging
2  AAAS   4.547958   4.386413 unchanging
```

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

Add title and change the colors

```
p + labs (title= "Some nice title") +
  scale_colour_manual( values=c("lightblue","gray","lightgreen") )
```



Exploring the gapminder dataset

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

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

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

Q. How many entry rows are in this dataset?

```
nrow(gapminder)
```

```
[1] 1704
```

Q. How many columns are in this dataset?

```
ncol(gapminder)
```

```
[1] 6
```

```
dim(gapminder)
```

```
[1] 1704    6
```

```
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
```

```
table(gapminder$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
```

How many continents?

```
table(gapminder$continent)
```

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

I could use the `unique` function...

```
unique(gapminder$continent)
```

```
[1] "Asia"     "Europe"   "Africa"   "Americas" "Oceania"
```

```
length(unique(gapminder$continent))
```

```
[1] 5
```

Q. How many countries?

```
unique(gapminder$country)
```

```
  [1] "Afghanistan"              "Albania"
  [3] "Algeria"                  "Angola"
  [5] "Argentina"                "Australia"
  [7] "Austria"                  "Bahrain"
  [9] "Bangladesh"               "Belgium"
 [11] "Benin"                    "Bolivia"
 [13] "Bosnia and Herzegovina"   "Botswana"
 [15] "Brazil"                   "Bulgaria"
 [17] "Burkina Faso"             "Burundi"
 [19] "Cambodia"                 "Cameroon"
 [21] "Canada"                   "Central African Republic"
 [23] "Chad"                     "Chile"
 [25] "China"                    "Colombia"
 [27] "Comoros"                  "Congo, Dem. Rep."
 [29] "Congo, Rep."              "Costa Rica"
 [31] "Cote d'Ivoire"            "Croatia"
 [33] "Cuba"                     "Czech Republic"
 [35] "Denmark"                  "Djibouti"
 [37] "Dominican Republic"       "Ecuador"
 [39] "Egypt"                    "El Salvador"
 [41] "Equatorial Guinea"        "Eritrea"
 [43] "Ethiopia"                 "Finland"
 [45] "France"                   "Gabon"
 [47] "Gambia"                   "Germany"
 [49] "Ghana"                    "Greece"
 [51] "Guatemala"                "Guinea"
 [53] "Guinea-Bissau"            "Haiti"
```

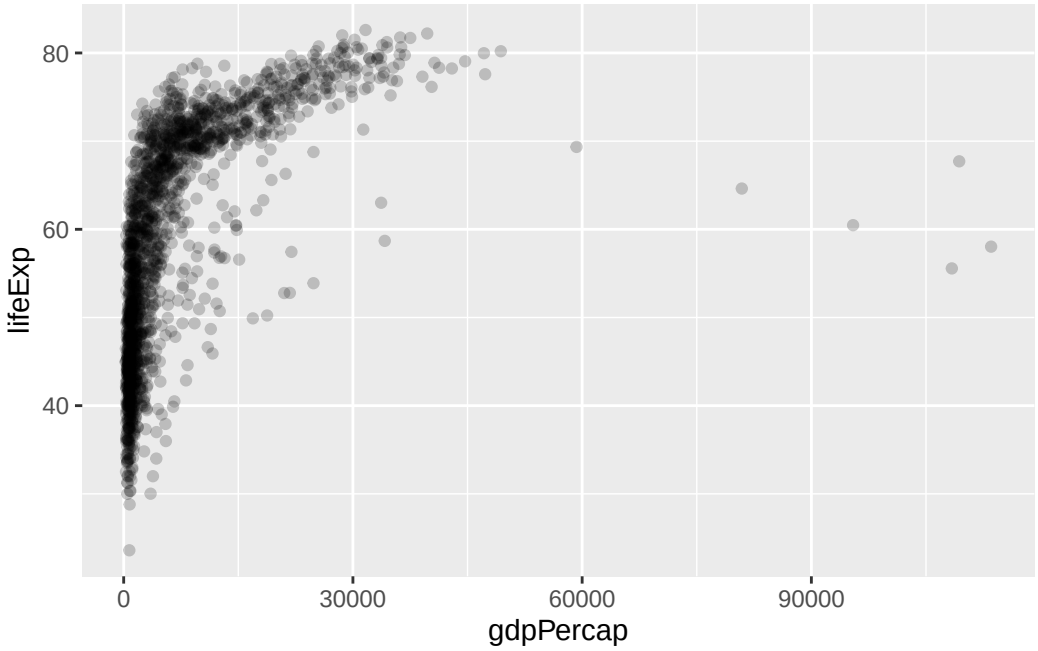
```
 [55] "Honduras"                "Hong Kong, China"
 [57] "Hungary"                 "Iceland"
 [59] "India"                   "Indonesia"
 [61] "Iran"                    "Iraq"
 [63] "Ireland"                 "Israel"
 [65] "Italy"                   "Jamaica"
 [67] "Japan"                   "Jordan"
 [69] "Kenya"                   "Korea, Dem. Rep."
 [71] "Korea, Rep."             "Kuwait"
 [73] "Lebanon"                 "Lesotho"
 [75] "Liberia"                 "Libya"
 [77] "Madagascar"              "Malawi"
 [79] "Malaysia"                "Mali"
 [81] "Mauritania"              "Mauritius"
 [83] "Mexico"                  "Mongolia"
 [85] "Montenegro"              "Morocco"
 [87] "Mozambique"              "Myanmar"
 [89] "Namibia"                 "Nepal"
 [91] "Netherlands"             "New Zealand"
 [93] "Nicaragua"               "Niger"
 [95] "Nigeria"                 "Norway"
 [97] "Oman"                    "Pakistan"
 [99] "Panama"                  "Paraguay"
[101] "Peru"                    "Philippines"
[103] "Poland"                  "Portugal"
[105] "Puerto Rico"             "Reunion"
[107] "Romania"                 "Rwanda"
[109] "Sao Tome and Principe"   "Saudi Arabia"
[111] "Senegal"                 "Serbia"
[113] "Sierra Leone"            "Singapore"
[115] "Slovak Republic"         "Slovenia"
[117] "Somalia"                 "South Africa"
[119] "Spain"                   "Sri Lanka"
[121] "Sudan"                   "Swaziland"
[123] "Sweden"                  "Switzerland"
[125] "Syria"                   "Taiwan"
[127] "Tanzania"                "Thailand"
[129] "Togo"                    "Trinidad and Tobago"
[131] "Tunisia"                 "Turkey"
[133] "Uganda"                  "United Kingdom"
[135] "United States"           "Uruguay"
[137] "Venezuela"               "Vietnam"
[139] "West Bank and Gaza"      "Yemen, Rep."
```

```
[141] "Zambia"                    "Zimbabwe"
```

```
length(unique(gapminder$country))
```

```
[1] 142
```

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




```
library(dplyr)
```

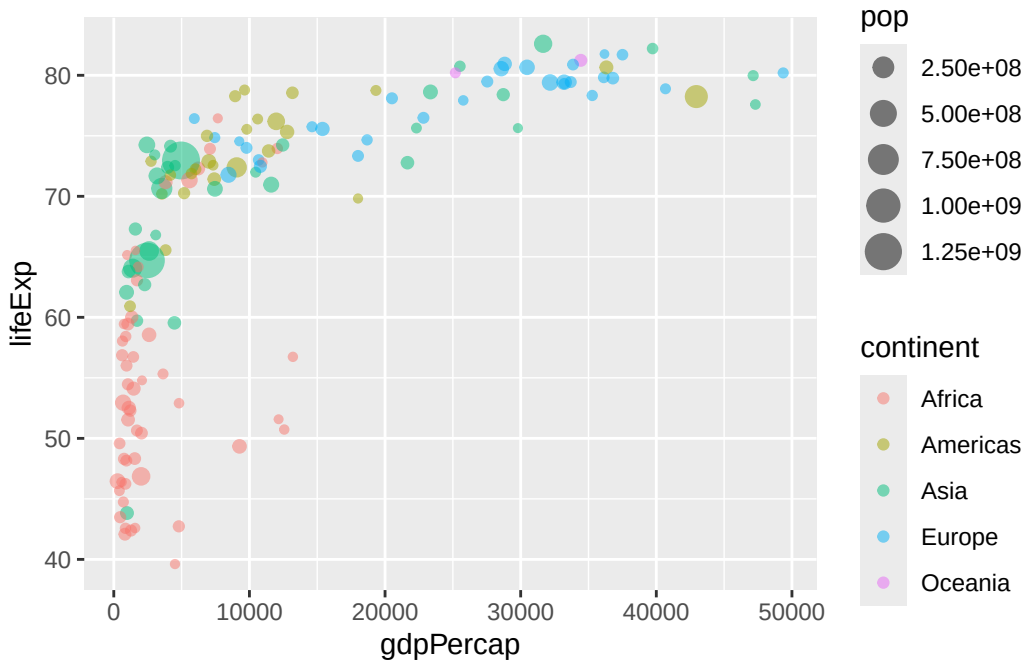
```
Attaching package: 'dplyr'
```

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

    filter, lag
```

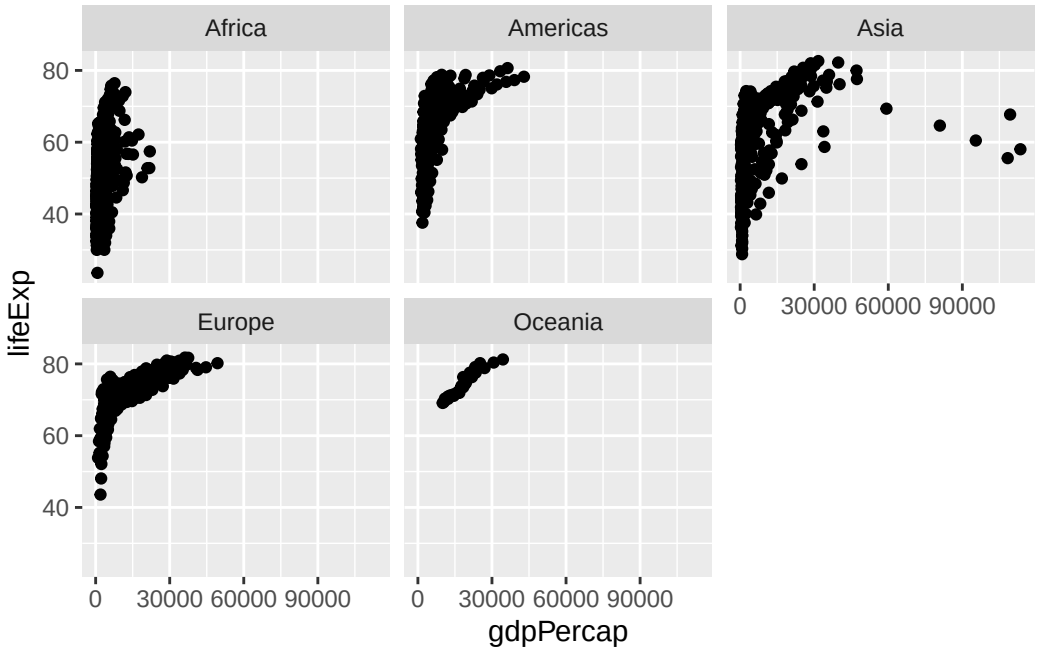
```
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

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

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




```
ggplot(gapminder) +
  aes(x=gdpPercap, y=lifeExp) +
  geom_point() +
facet_wrap(~continent)
```


Africa
Americas
Asia
Europe
Oceania
lifeExp
80
60
40
0
30000
60000
90000
gdpPercap