WhyR

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1. Why R - packages to be used

```
install.packages('dplyr', 'scales', 'RColorBrewer', 'yarrr', 'RCurl', 'findviews')
install.packages('ggplot2')
```

```
library(dplyr)
library(ggplot2)
library(scales)
library(RColorBrewer)
library(RCurl)
library(findviews)
library(yarrr)
```

2. How R structures data - the data frame

Working with built-in data sets

```
data("mtcars")

head(mtcars) # gives us the first six rows alt. head(mtcars, 10)
```

```
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

```
summary(mtcars) # summary stats
```

```
##       mpg             cyl             disp             hp       
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0  
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5  
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0  
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7  
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0  
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0  
##       drat             wt             qsec             vs        
##  Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000  
##  1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000  
##  Median :3.695   Median :3.325   Median :17.71   Median :0.0000  
##  Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375  
##  3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000  
##  Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000  
##        am              gear             carb      
##  Min.   :0.0000   Min.   :3.000   Min.   :1.000  
##  1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000  
##  Median :0.0000   Median :4.000   Median :2.000  
##  Mean   :0.4062   Mean   :3.688   Mean   :2.812  
##  3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000  
##  Max.   :1.0000   Max.   :5.000   Max.   :8.000
```

```r
str(mtcars) # structure of your data set
```

```
## 'data.frame':    32 obs. of  11 variables:
##  $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
##  $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
##  $ disp: num  160 160 108 258 360 ...
##  $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
##  $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
##  $ wt  : num  2.62 2.88 2.32 3.21 3.44 ...
##  $ qsec: num  16.5 17 18.6 19.4 17 ...
##  $ vs  : num  0 0 1 1 0 1 0 1 1 1 ...
##  $ am  : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
##  $ carb: num  4 4 1 1 2 1 4 2 2 4 ...
```

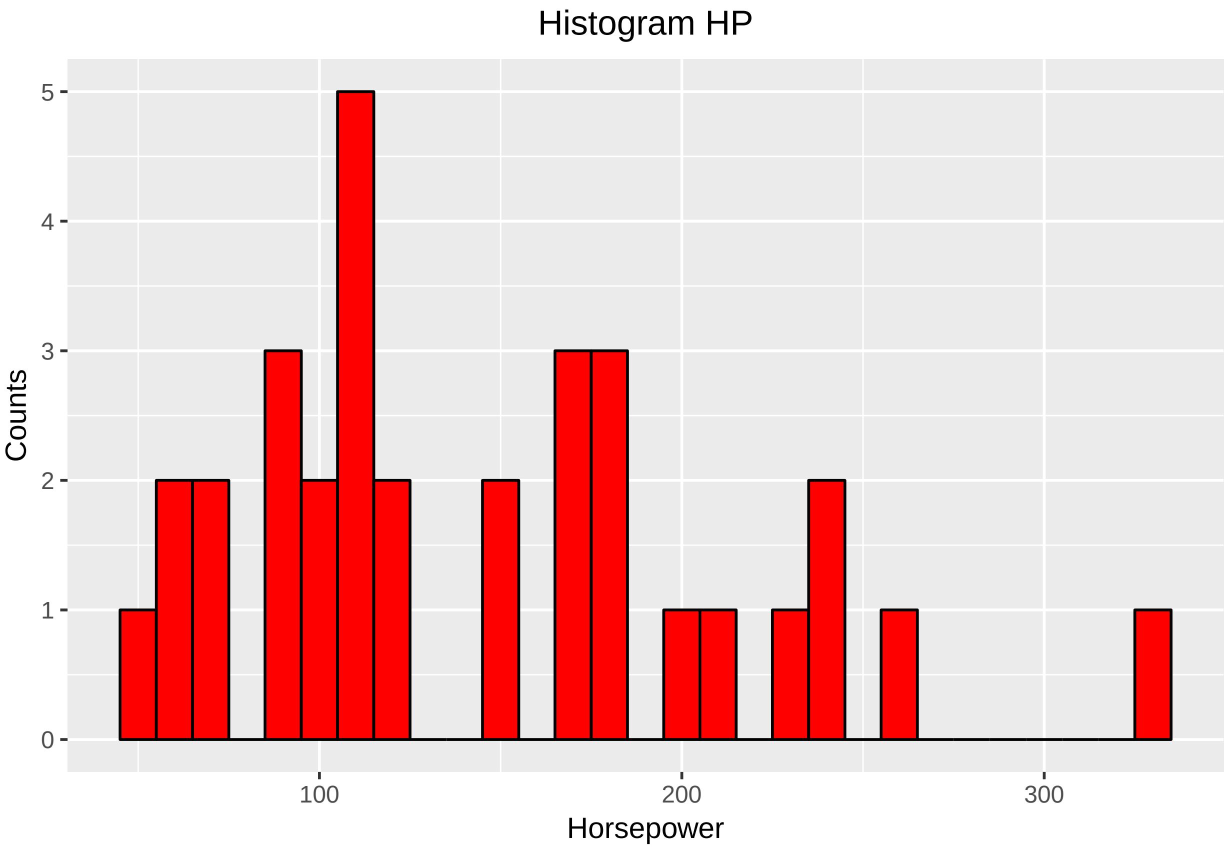
```r
#findviews(mtcars) # gives you a great overview of categorical and continous variables

#View(mtcars) # brings up the data set
```

Now, that we have a general idea of how our data is structured, lets do some exploratory data analysis

This is what we are using the ggplot2 package for

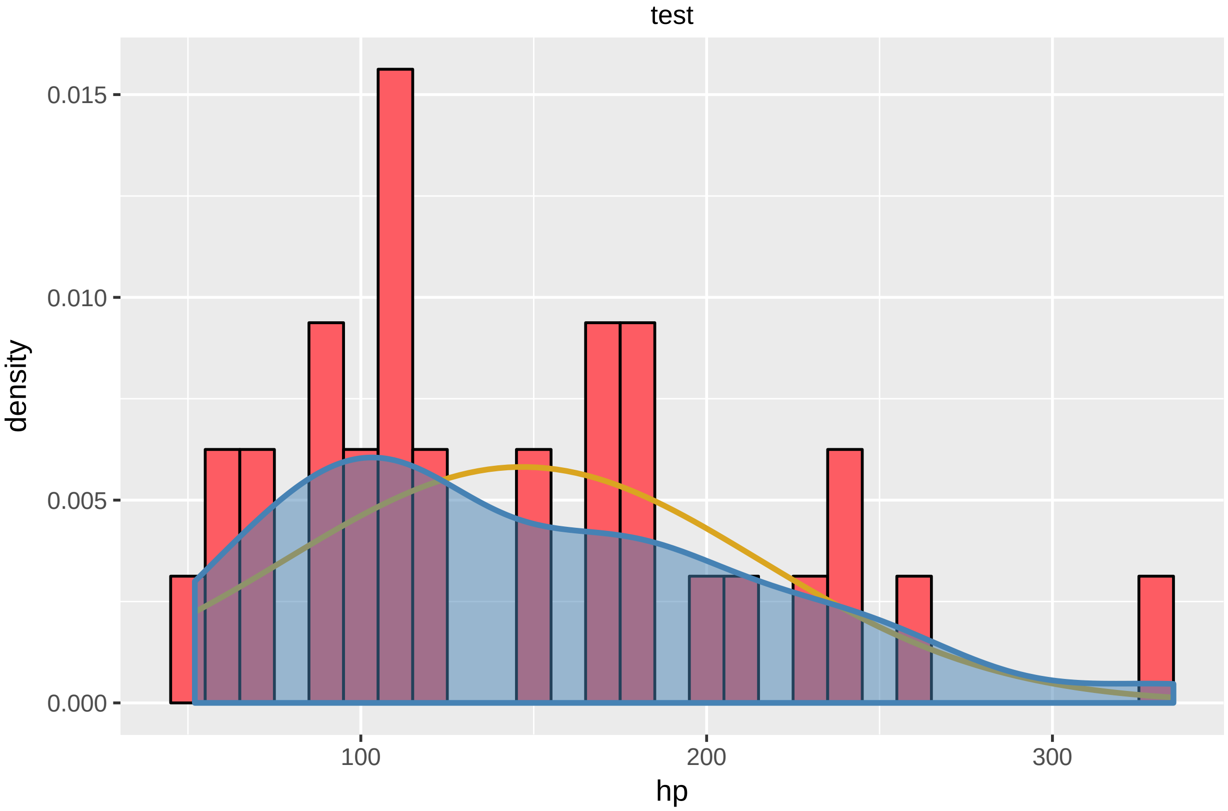
3. Histogram for quantitative variables

```r
ggplot(mtcars, aes(hp)) +
        geom_histogram(binwidth = 10, fill = "red", col = "black") +
        ggtitle("Histogram HP") +
        xlab("Horsepower") +
        ylab("Counts") +
        theme(plot.caption = element_text(hjust=0.5), plot.title = element_text(hjust = 0.5))
```



Alternatively (or additionally), we can overlay the density curve and the normal distribution

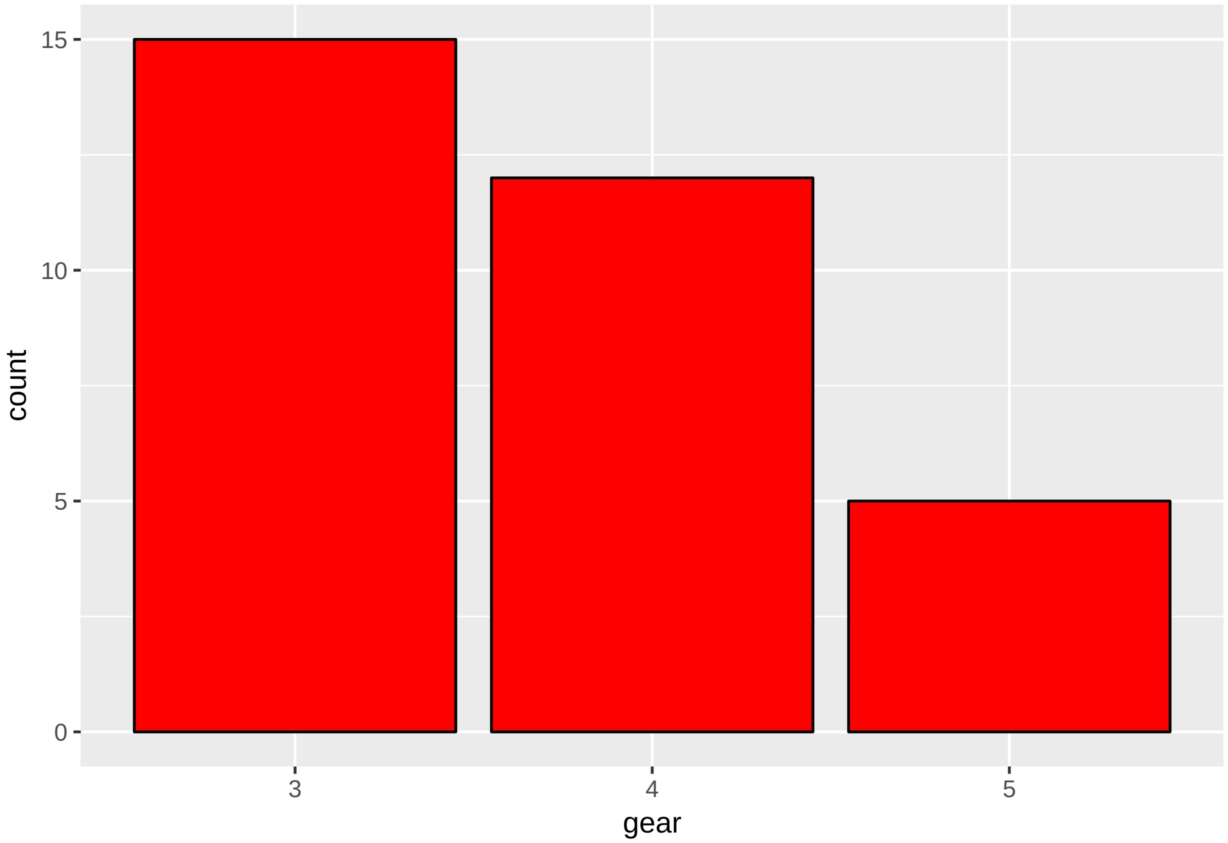
```
ggplot(mtcars, aes(hp)) +
        geom_histogram(aes(y = ..density..), fill = "#fd5c63", binwidth = 10, col = "black") +
        stat_function(fun = dnorm, color = "goldenrod", lwd = 1,
                      args=list(mean = mean(mtcars$hp), sd = sd(mtcars$hp))) +
        geom_density(color = "steelblue", lwd = 1, fill = "steelblue", alpha = .5) +
        labs(subtitle = "test", caption = 'test') +
        theme(plot.caption = element_text(hjust=0.5), plot.subtitle = element_text(hjust = 0.5))
```



test

4. Barplot for categorical variables

```
mtcars2 <- mtcars
mtcars2 <- mutate(mtcars, gear = as.factor(gear)) # we have to change gear from num to fact

ggplot(mtcars2, aes(gear)) +
        geom_bar(fill = "red", col = "black")
```

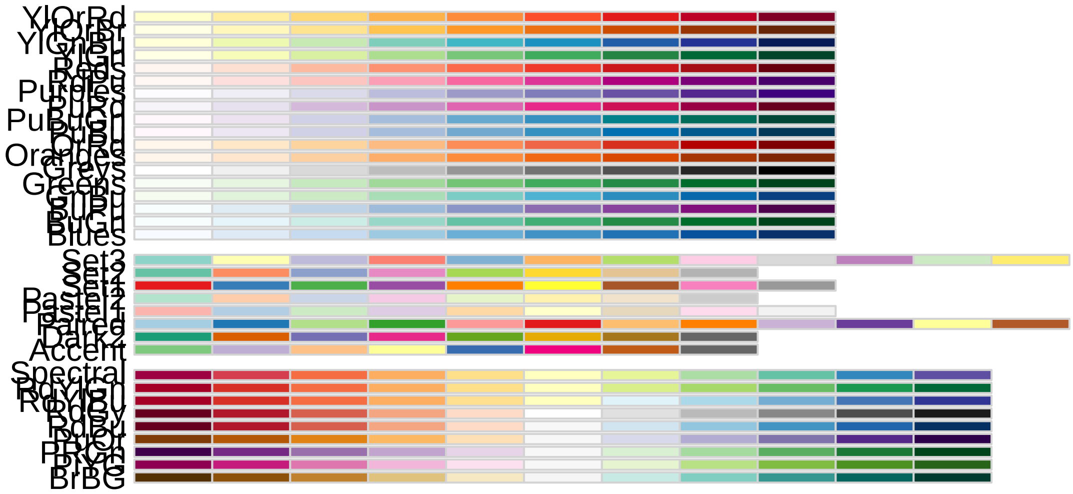


5. Working with colors - get brandcolors - woohoo - brandcolors.net (hex-code)

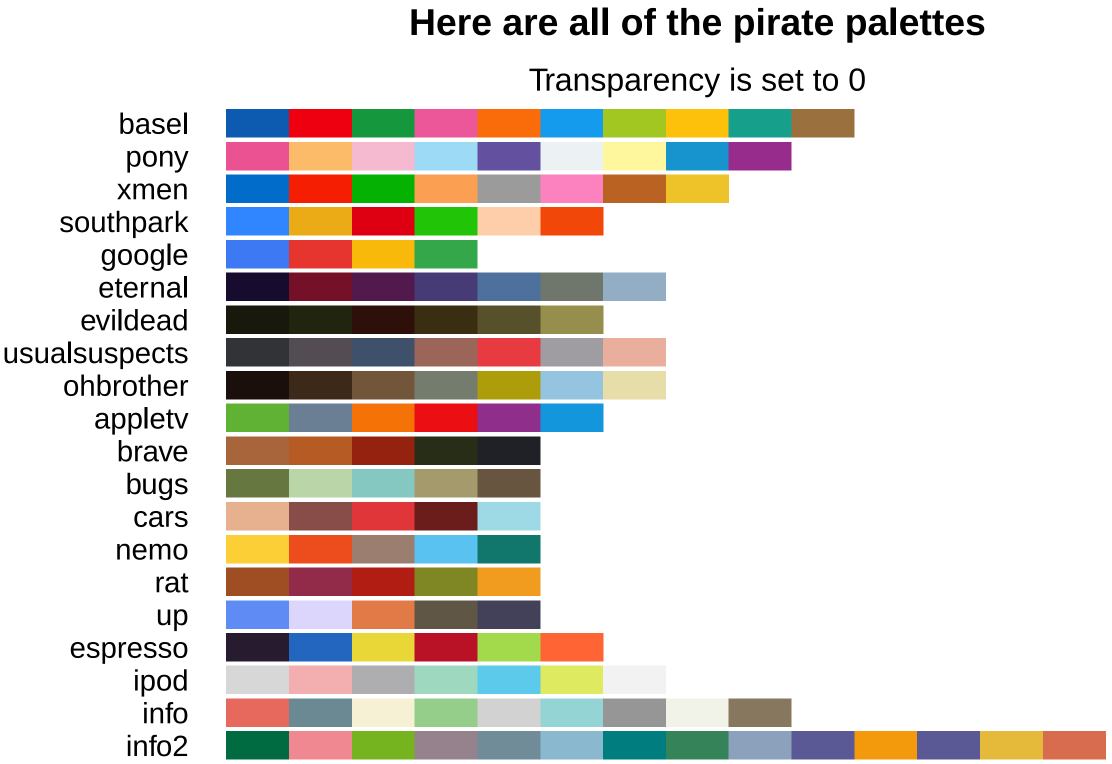
```
myColors <- c("#1da1f2", "#fd5c63", "#003a70")
names(myColors) <- levels(mtcars2$gear)
names(myColors) <- c("4", "3", "5") # change the level-colors according to order
```

Colors with RColorBrewer and yarrr

```
display.brewer.all()
```



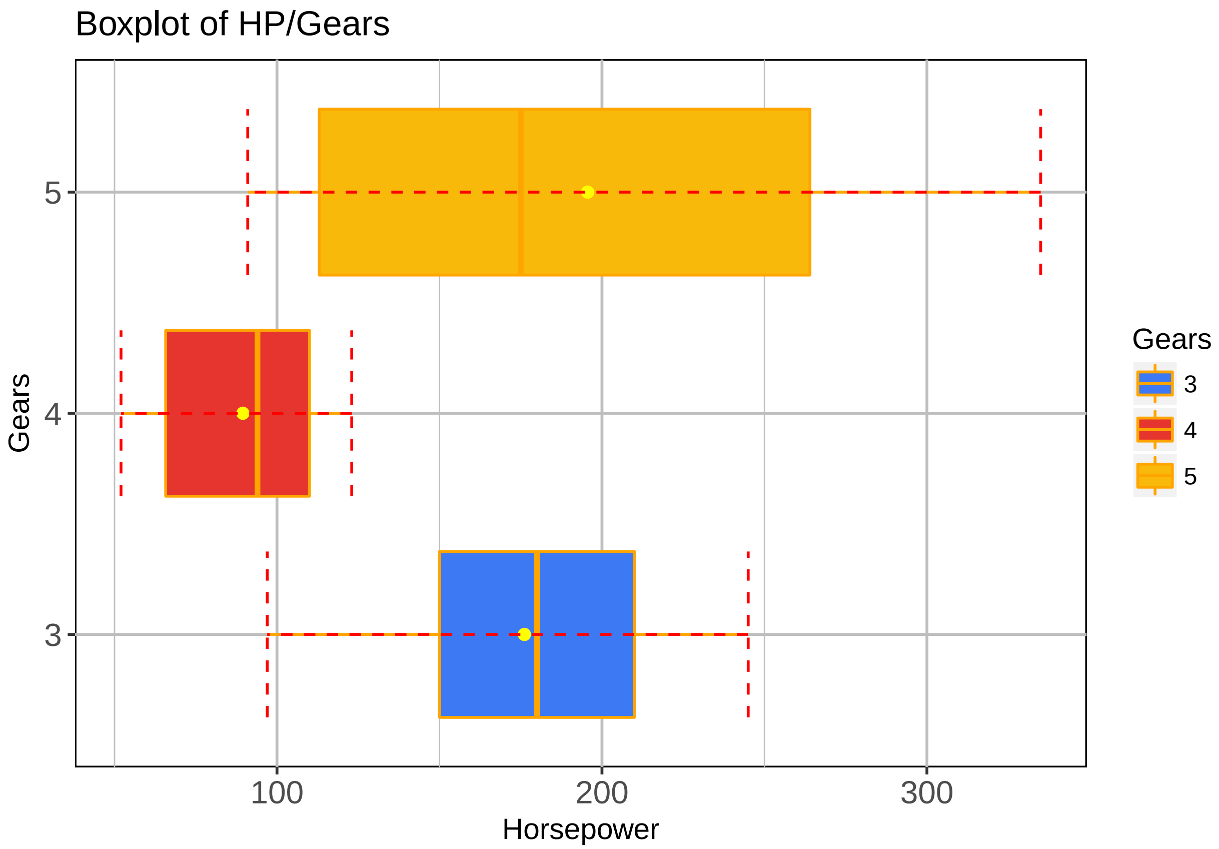
```
myColors2 <- brewer.pal(3, "Pastel1")

piratepal(palette = "all") # yarrr
```



```
myColors3 <- unname(piratepal(palette = "google"))
```

6. Boxplots for quantitative variables

```
ggplot(mtcars2, aes(gear, hp)) +
        geom_boxplot(aes(fill = gear), col = "orange", show.legend = TRUE) +
        scale_fill_manual(name = "Gears", values = myColors3) +
        coord_flip() +
        stat_summary(fun.y=mean, geom="point", shape=16, size=2, col = "yellow") +
        stat_boxplot(geom = "errorbar", col = "red", lty = 2) +
        theme(axis.text = element_text(size = 12),
              panel.grid.major = element_line(color = "grey"),
              panel.grid.minor = element_line(color = "grey"), # element_blank() gets rid of minor grid
              panel.background = element_rect(fill = "white", color = "black"))+
        ggtitle("Boxplot of HP/Gears") +
        xlab("Gears") +
        ylab("Horsepower")
```



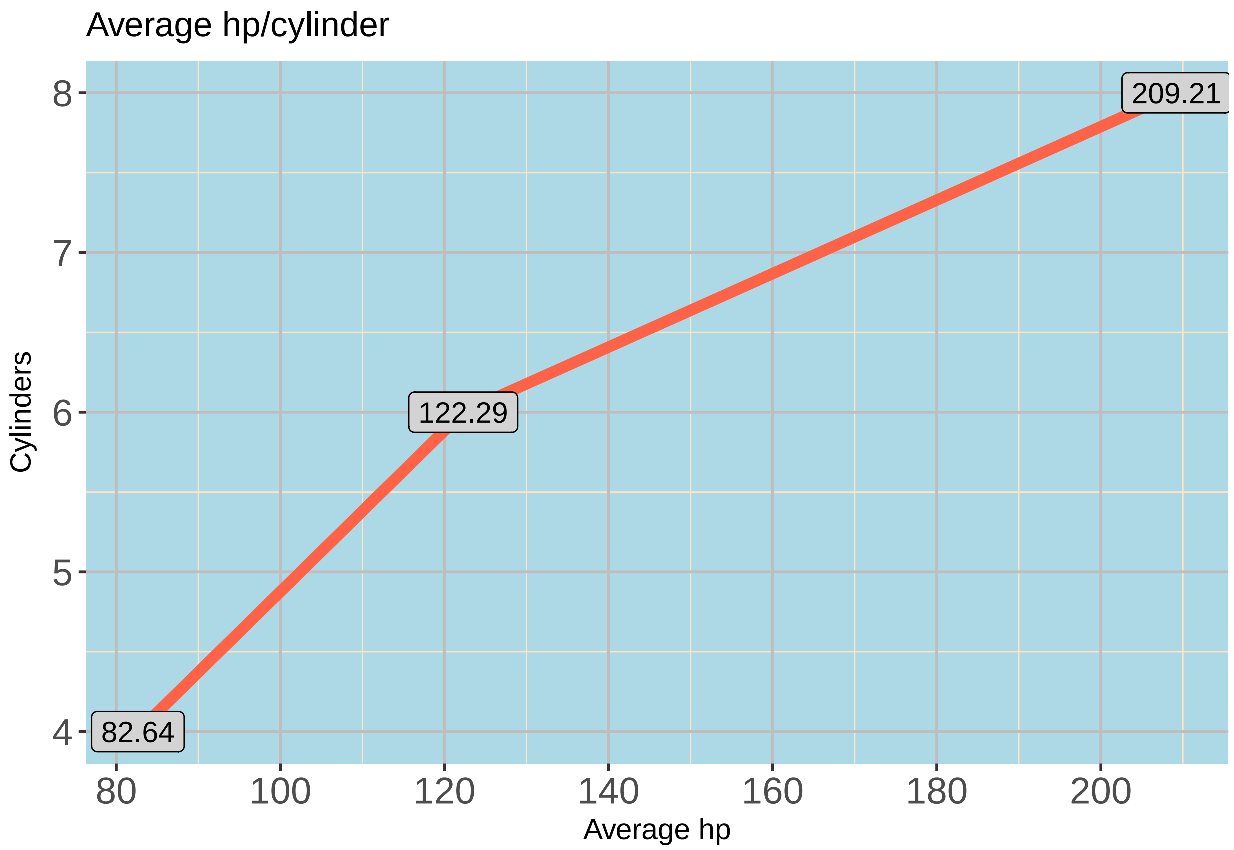
7. It is getting more intense - we are going to plot the meanHP/cylinder

Some data-processing to get mean hp (we create a new dataset with meanHP and cyl from mtcars)

```
meanHp <- mtcars %>%
        group_by(cyl) %>%
        filter(!is.na(hp)) %>%
        summarize(avg_hp = mean(hp, na.rm=TRUE))
```

Actual plot

```
p1 <- ggplot(meanHp, aes(avg_hp, cyl, label = round(avg_hp, 2))) +
        geom_line(lwd = 2, col = "tomato") +
        geom_text(check_overlap = TRUE) + # the text and label add-ons overwrite the points!
        geom_label(color = "black", bg = "lightgrey") +
        ggtitle("Average hp/cylinder") +
        ylab("Cylinders") +
        xlab("Average hp") +
        scale_x_continuous(breaks=seq(0,220,20)) + # set tick marks manually
        theme(
                axis.text = element_text(size = 14),
                panel.grid.major = element_line(color = "grey"),
                panel.grid.minor = element_line(color = "bisque"), # element_blank() gets rid of minor
                panel.background = element_rect(fill = "lightblue"))

p1
```



Saving the plot as a .png file

```
ggsave(p1, filename = "AvgHP.png")
```

8. Now for the fun part, working with real-life online data (RCurl package) - crime statistics

Getting the data

```
onlineData <- getURL("http://www.onthelambda.com/wp-content/uploads/2014/07/CrimeStatebyState.csv",
                     ssl.verifyhost=FALSE, ssl.verifypeer=FALSE)

class(onlineData) # needs to be put into a dataframe
```

```
## [1] "character"
```

```
crimeData <- read.csv(textConnection(onlineData), header = TRUE)
rm(onlineData) # removes onlineData so we can keep everything nice and clean
```

9. Plot crime counts per year

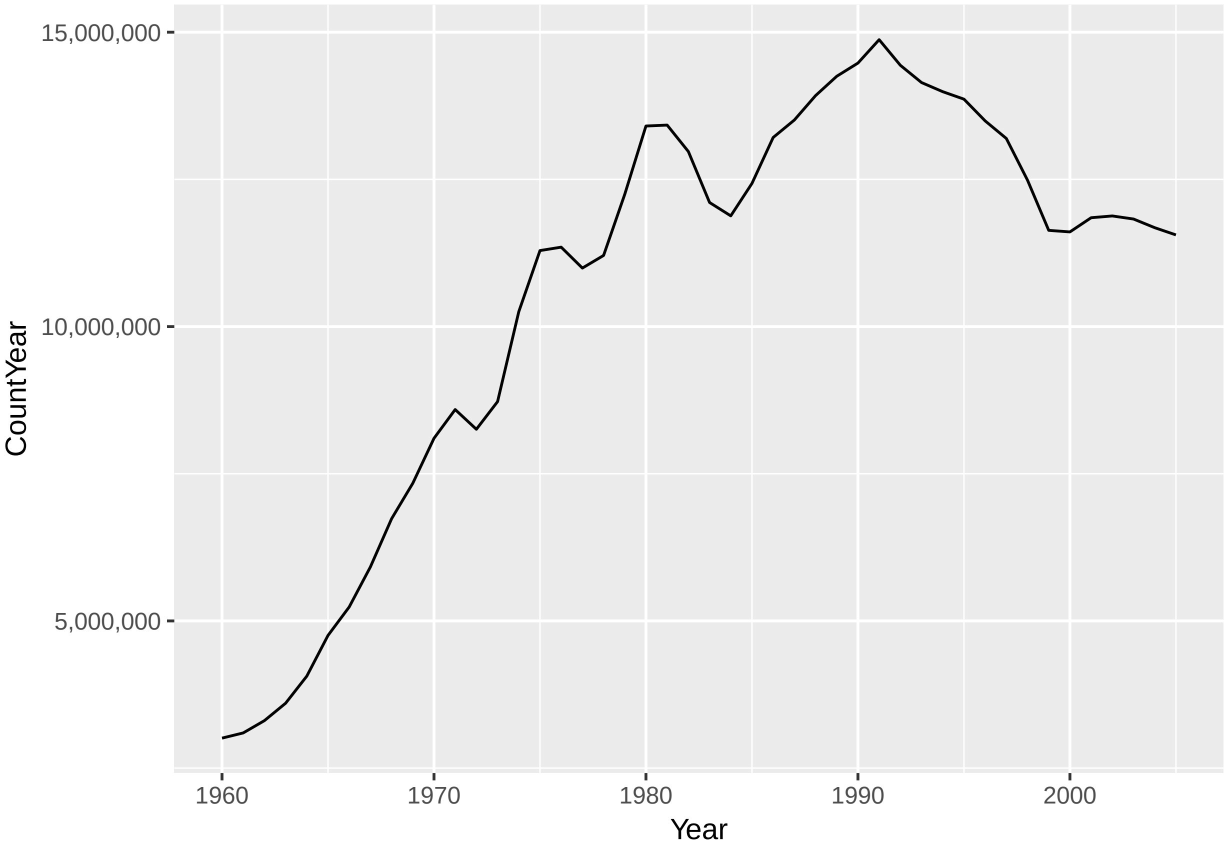
```
head(crimeData)
```

```
##     State Type.of.Crime                                Crime Year Count
## 1 Alabama Violent Crime Murder and nonnegligent Manslaughter 1960   406
## 2 Alabama Violent Crime Murder and nonnegligent Manslaughter 1961   427
## 3 Alabama Violent Crime Murder and nonnegligent Manslaughter 1962   316
## 4 Alabama Violent Crime Murder and nonnegligent Manslaughter 1963   340
## 5 Alabama Violent Crime Murder and nonnegligent Manslaughter 1964   316
## 6 Alabama Violent Crime Murder and nonnegligent Manslaughter 1965   395
```

```
str(crimeData)
```

```
## 'data.frame':    16422 obs. of  5 variables:
##  $ State        : Factor w/ 51 levels "Alabama","Alaska",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Type.of.Crime: Factor w/ 2 levels "Property Crime",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ Crime        : Factor w/ 7 levels "Aggravated assault",..: 6 6 6 6 6 6 6 6 6 6 ...
##  $ Year         : int  1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 ...
##  $ Count        : int  406 427 316 340 316 395 384 415 421 485 ...
```

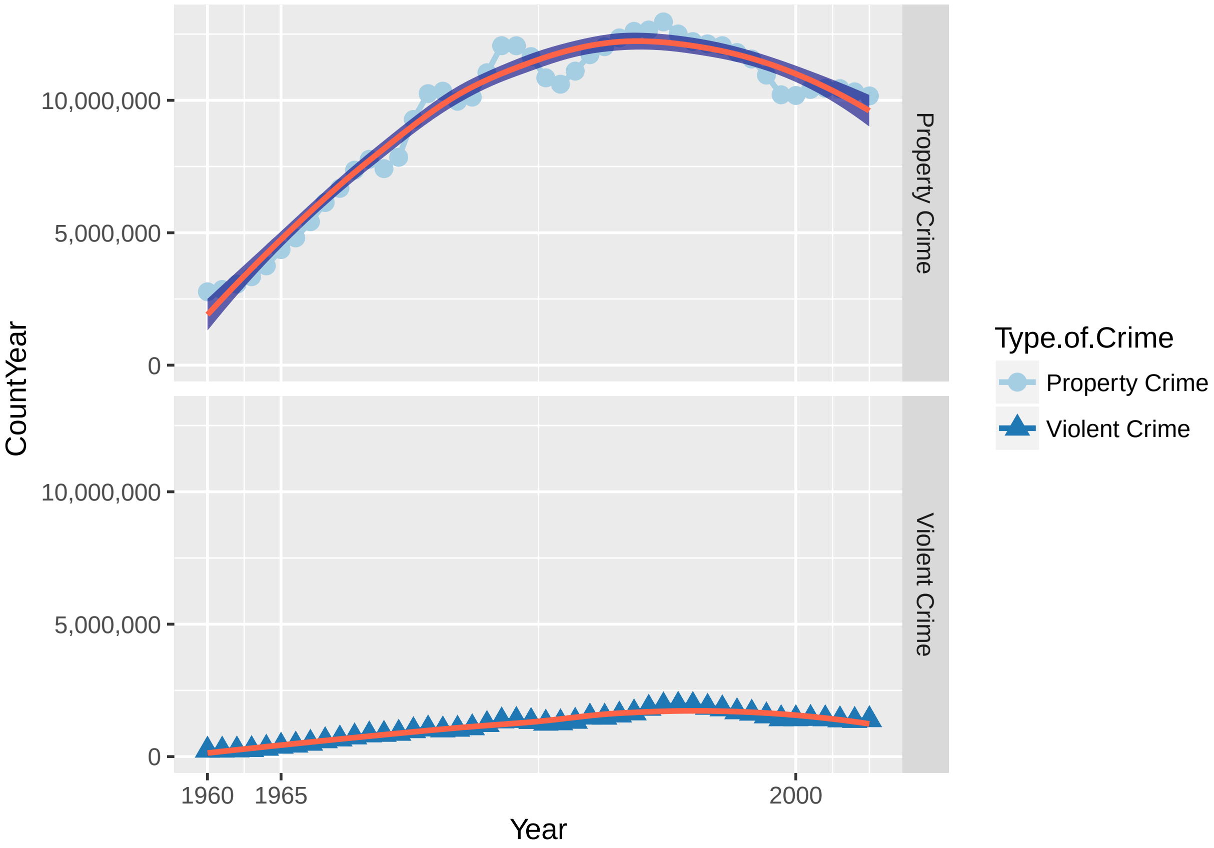
```
crimeCountYear <- crimeData %>%
        group_by(Year) %>%
        summarize(CountYear = sum(Count))

ggplot(crimeCountYear, aes(Year, CountYear)) +
        geom_line() +
        scale_y_continuous(labels = comma)
```



```
crimeCountYear2 <- crimeData %>%
        group_by(Year, Type.of.Crime) %>%
        summarize(CountYear = sum(Count))
```

```
ggplot(crimeCountYear2, aes(Year, CountYear, col = Type.of.Crime, shape = Type.of.Crime)) +
        geom_line(lwd = 1) +
        geom_point(size = 3) +
        scale_color_manual(values = brewer.pal(2, "Paired")) +
        geom_smooth(method = "loess", na.rm = TRUE, se=TRUE, fullrange = TRUE, fill = "navy", color = '
        facet_grid(Type.of.Crime ~.) +
        scale_x_continuous(breaks = c(1960, 1965, 2000)) +
        scale_y_continuous(labels = comma)
```

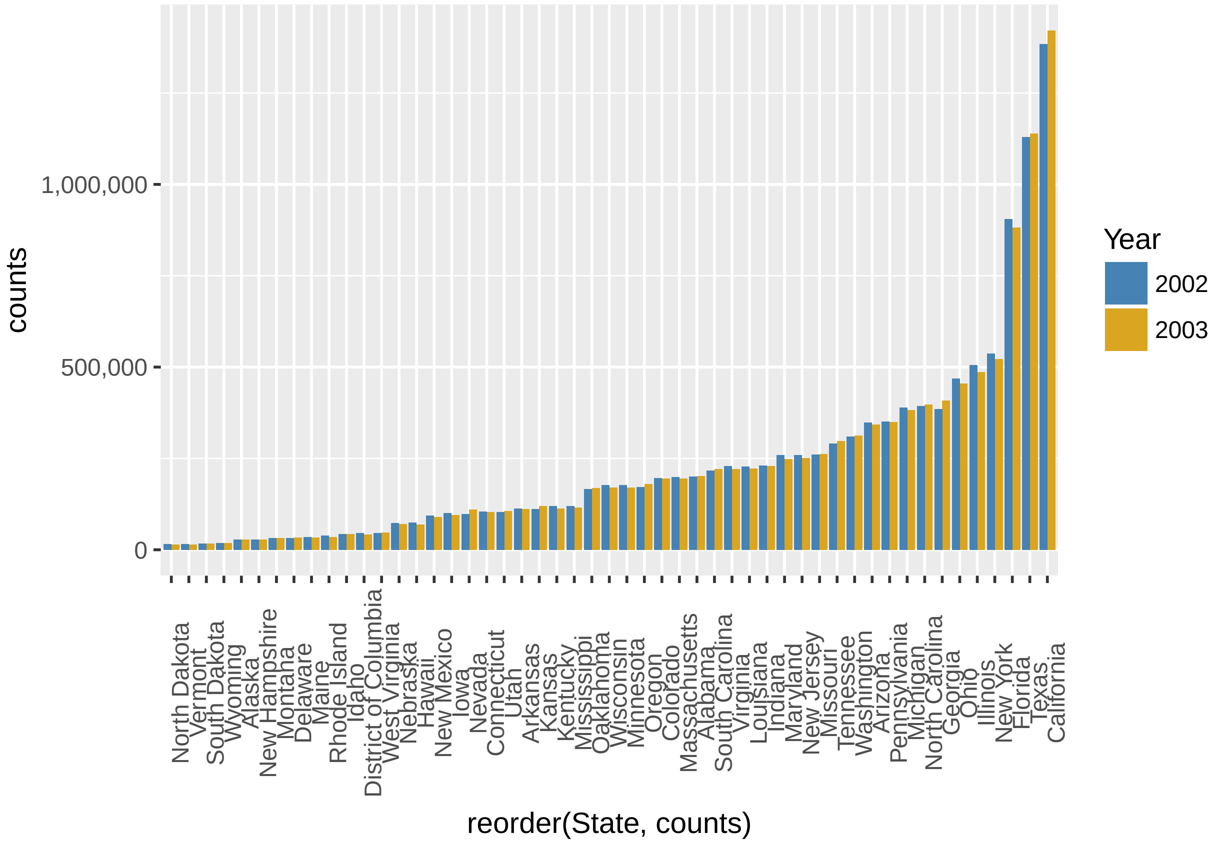
```
## Warning in brewer.pal(2, "Paired"): minimal value for n is 3, returning requested palette with 3 dif
```



10. We are getting more selective (only years 2002 and 2003)

```
crimeSel <- crimeData %>%
        filter(Year == 2002:2003 & !is.na(Year)) %>%
        group_by(State, Year) %>%
        summarize(counts = sum(Count)) %>%
        arrange(desc(counts))
```

```
crimeSel$Year <- as.factor(crimeSel$Year)

ggplot(crimeSel, aes(reorder(State, counts), counts, fill = Year)) +
        geom_bar(stat = "identity", position = "dodge") +
        scale_fill_manual(values = c("steelblue", "goldenrod")) +
        theme(axis.text.x = element_text(angle = 90)) +
        scale_y_continuous(labels = comma)
```

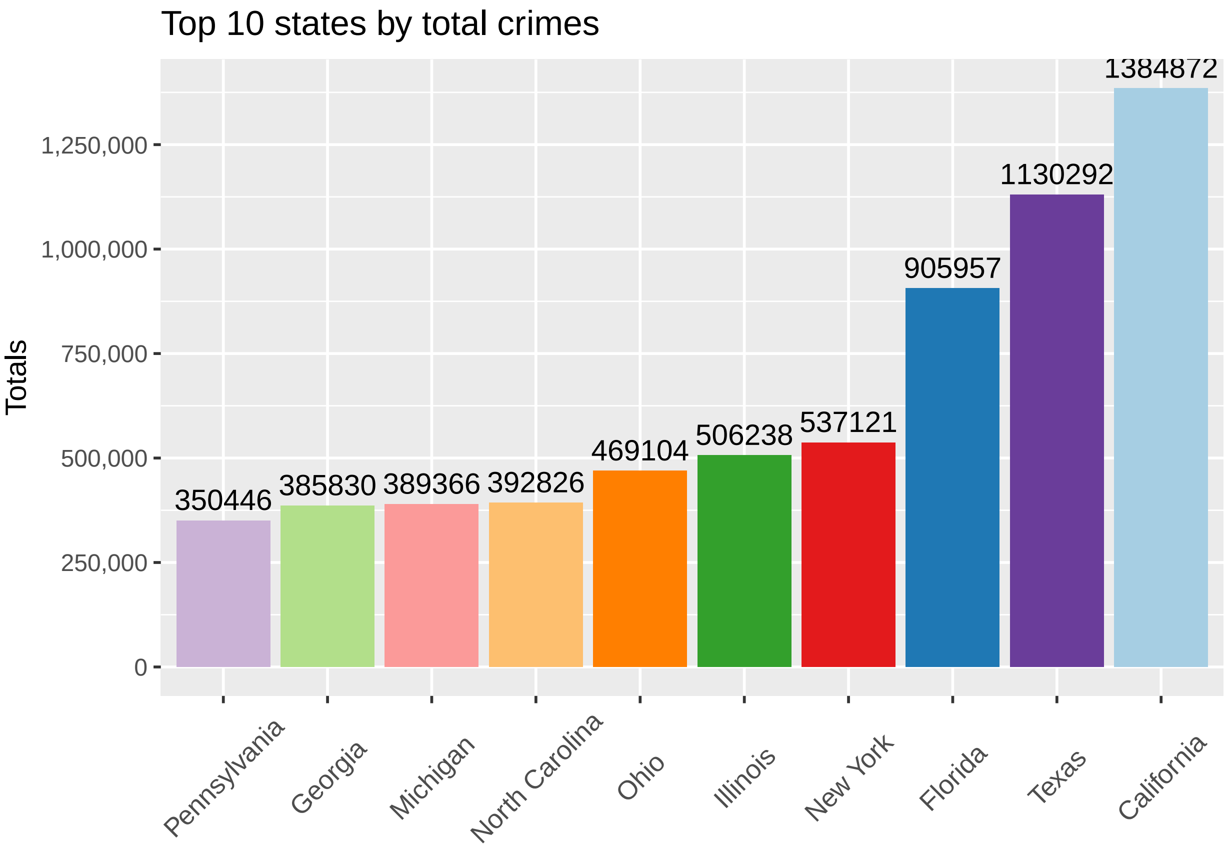


11. Finally, we are going to plot the top ten of year 2000

```
crime2000 <- crimeData %>%
        filter(Year == 2002) %>%
        group_by(State) %>%
        summarize(counts = sum(Count)) %>%
        arrange(desc(counts)) %>%
        filter(counts > 350445)

head(crime2000,10)
```

```
## # A tibble: 10 × 2
##             State  counts
##            <fctr>   <int>
## 1      California 1384872
## 2           Texas 1130292
## 3         Florida  905957
## 4        New York  537121
## 5        Illinois  506238
## 6            Ohio  469104
## 7  North Carolina  392826
## 8        Michigan  389366
## 9         Georgia  385830
## 10   Pennsylvania  350446
```

```r
library(scales) # for label formatting
library(RColorBrewer)

crime <- ggplot(crime2000, aes(reorder(State,counts), counts)) +
        geom_bar(stat = "identity", aes(fill = State)) +
        scale_fill_manual(values = brewer.pal(10, "Paired"), guide = FALSE) +
        theme(axis.text.x  = element_text(angle=45, vjust=0.5, size=10), axis.title.x = element_blank()
        scale_y_continuous(labels = comma, breaks = c(0, 250000, 500000, 750000, 1000000, 1250000)) + #
        geom_text(aes(State, counts, label = counts), vjust = -0.5) +
        ggtitle("Top 10 states by total crimes") +
        ylab("Totals")
crime
```



Saving the plot

```r
ggsave(crime, filename = "crimePlot.png")
```

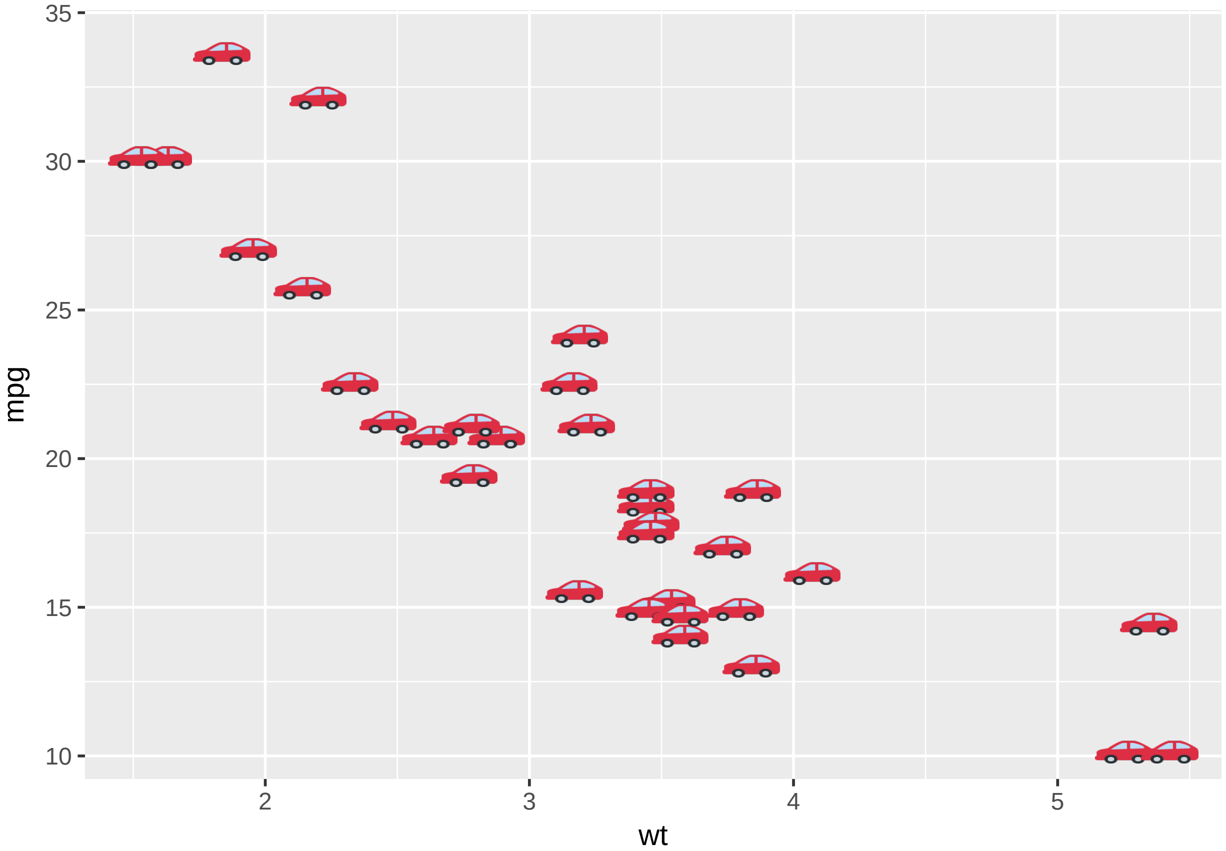
12. Gimmick - plotting with emojis

```r
devtools::install_github("dill/emoGG")

library(ggplot2)
library(emoGG)
```

```
## Find an emoji you want to use

emoji_search("car")
```

```
##                     emoji  code        keyword
## 1753                  bus 1f68c            car
## 1762              minibus 1f690            car
## 1797                  car 1f697            red
## 1798                  car 1f697 transportation
## 1799                  car 1f697        vehicle
## 1800 oncoming_automobile 1f698            car
## 1812              tractor 1f69c            car
## 2733                    a 1f170     red-square
## 2734                    a 1f170       alphabet
## 2735                    a 1f170         letter
```

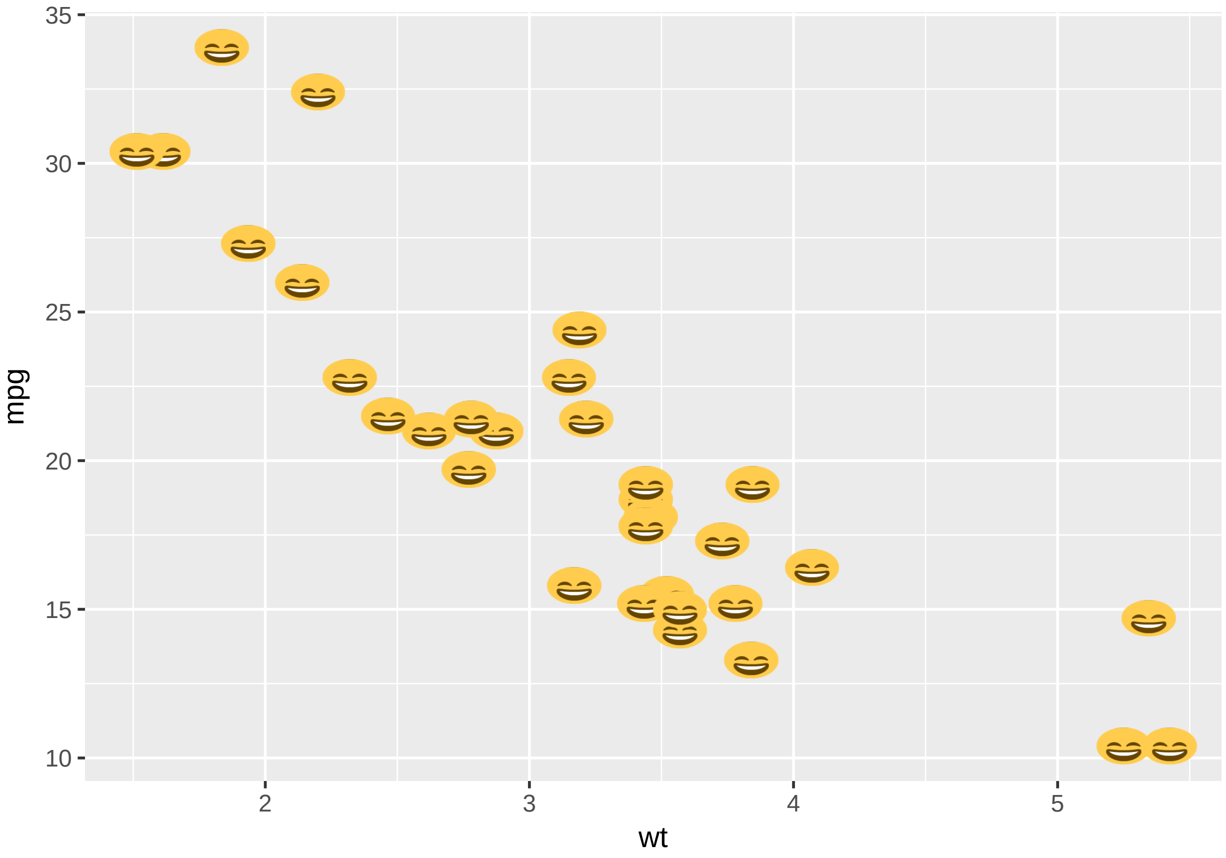
```
ggplot(mtcars, aes(wt, mpg)) +
        geom_emoji(emoji="1f697")
```



```
emoji_search('smiley')
```

```
##                              emoji  code      keyword
## 2                         grinning 1f600        smile
## 7                             grin 1f601        smile
## 15                          smiley 1f603         face
## 16                          smiley 1f603        happy
## 17                          smiley 1f603          joy
## 18                          smiley 1f603         haha
## 19                                smile 1f604        face
## 20                                smile 1f604       happy
## 21                                smile 1f604         joy
## 22                                smile 1f604       funny
## 23                                smile 1f604        haha
## 24                                smile 1f604       laugh
## 25                                smile 1f604        like
## 51                                blush 1f60a       smile
## 65                                  yum 1f60b       smile
## 83                           sunglasses 1f60e       smile
## 87                                smirk 1f60f       smile
## 149                    stuck_out_tongue 1f61b       smile
## 155  stuck_out_tongue_winking_eye 1f61c       smile
## 160  stuck_out_tongue_closed_eyes 1f61d       smile
## 3128                                  m   24c2    alphabet
## 3129                                  m   24c2 blue-circle
## 3130                                  m   24c2      letter
```

```r
ggplot(mtcars, aes(wt, mpg)) +
        geom_emoji(emoji="1f604")
```


mpg
wt