Data Visualization with ggplot2 (EDA approach)

Contents


```
library(tidyverse)
library(RColorBrewer) # brewer.pal()  package
```

#Dataset: mtcars

```
 1974 Motor Trend US magazine
 1973-1974 32  (n=32)
11          (p=11)
```

```
mtcars
```

```
##                    mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
## Duster 360        14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Merc 240D         24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## Merc 230          22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## Merc 280          19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## Merc 280C         17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
## Merc 450SE        16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
## Merc 450SL        17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
```

```
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
## Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
## Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
## Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
## AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
## Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
## Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
## Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
## Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
```

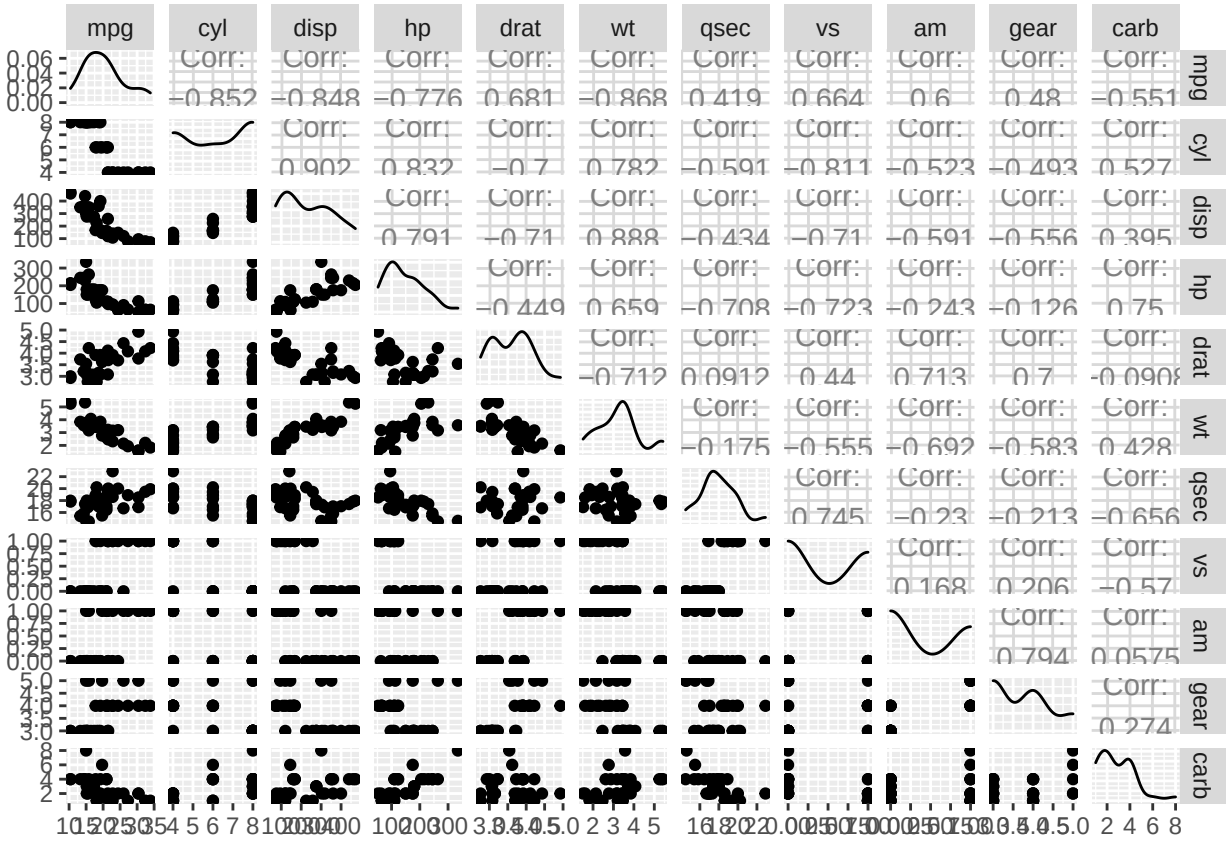
```
? mtcars
```

- mpg: miles per gallon ( )
- cyl: Number of cylinders ?
- disp: Displacement(cu.in.)
- hp: Gross horsepower
- drat: Rear axle ratio ;
- wt: Weight(lb / 1000)
- qsec: 1/4 mile time 1/4 mile ( );
- vs: V/S V Straight ( );
- am: Transmission(0 = automatic, 1 = manual) or
- gear: Number of forward gears ; ?
- carb: Number of carburetors ; ?

#

GGally:ggpairs()

```
library(GGally)
ggpairs(mtcars)
```



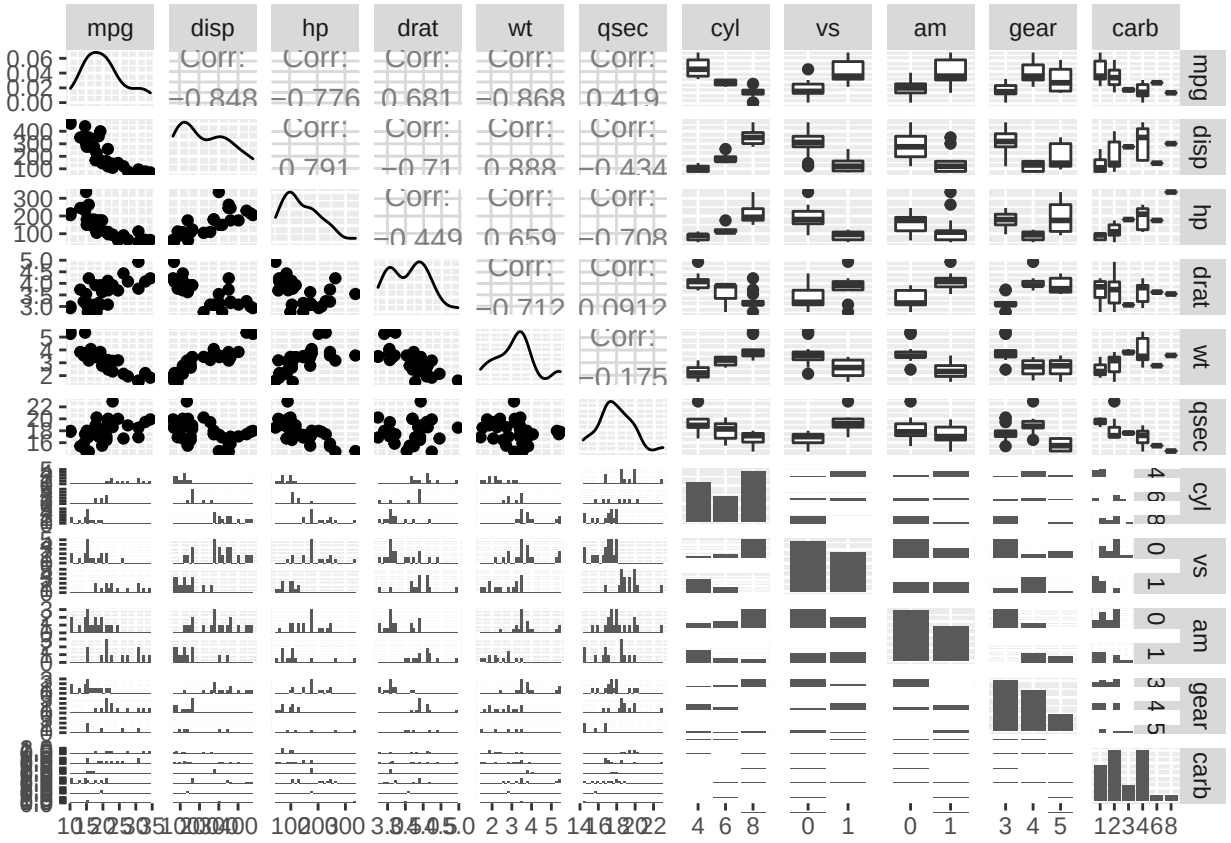
distribution association/correlation
“ ”

`cyl`, `vs`, `am`, `gear`, `carb`

ggpairs

distribution, association/correlation

```
mtcars <- mutate(mtcars, cyl = factor(cyl), vs = factor(vs),
                 am = factor(am), gear = factor(gear),
                 carb=factor(carb)) %>%
        select(mpg, disp:qsec, cyl, vs:carb)
ggpairs(mtcars)
```



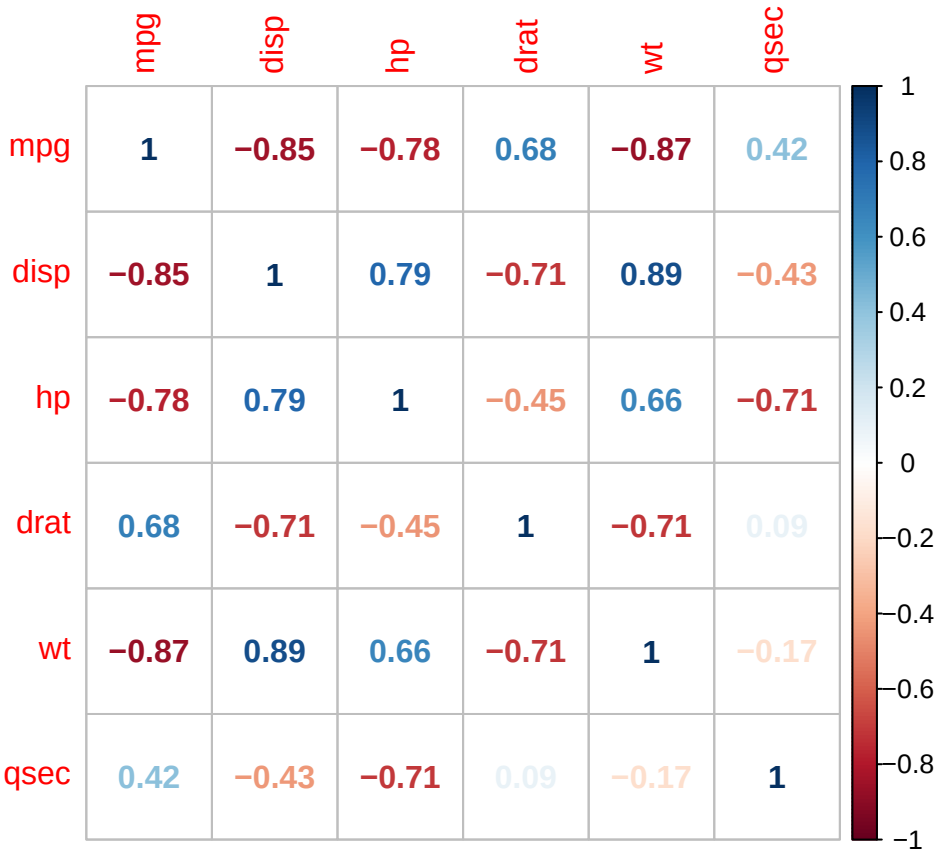
summary

```
summary(mtcars)
```

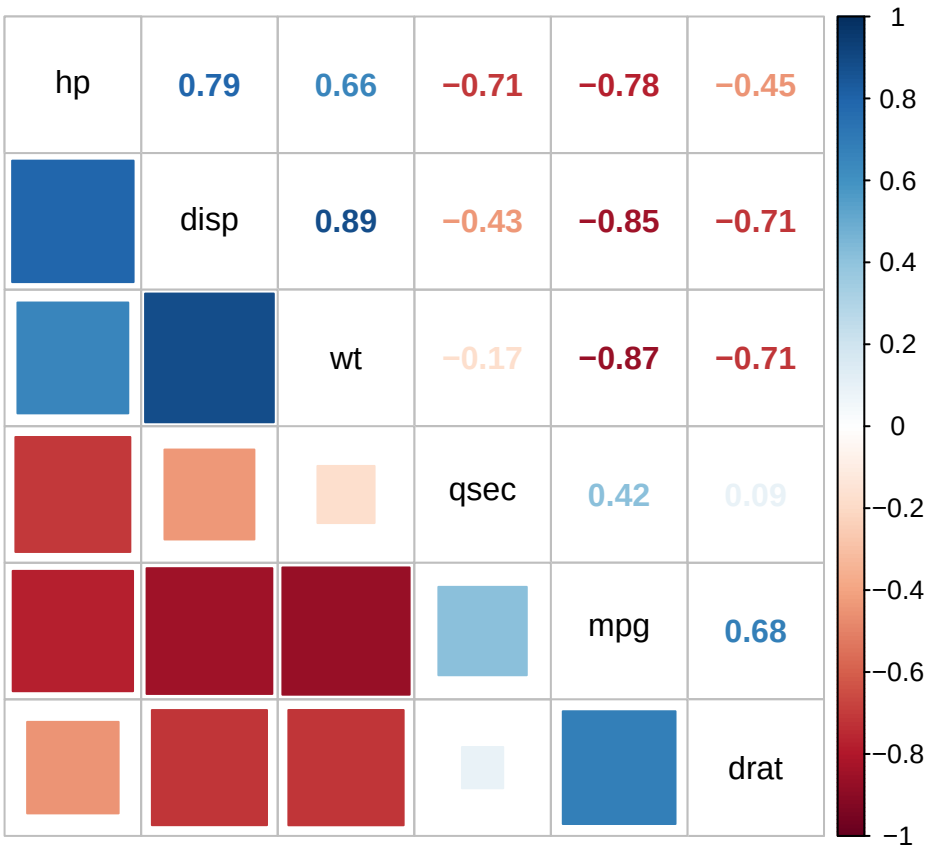
```
##       mpg             disp             hp             drat      
##  Min.   :10.40   Min.   : 71.1   Min.   : 52.0   Min.   :2.760  
##  1st Qu.:15.43   1st Qu.:120.8   1st Qu.: 96.5   1st Qu.:3.080  
##  Median :19.20   Median :196.3   Median :123.0   Median :3.695  
##  Mean   :20.09   Mean   :230.7   Mean   :146.7   Mean   :3.597  
##  3rd Qu.:22.80   3rd Qu.:326.0   3rd Qu.:180.0   3rd Qu.:3.920  
##  Max.   :33.90   Max.   :472.0   Max.   :335.0   Max.   :4.930  
##        wt             qsec       cyl    vs     am     gear   carb  
##  Min.   :1.513   Min.   :14.50   4:11   0:18   0:19   3:15   1: 7  
##  1st Qu.:2.581   1st Qu.:16.89   6: 7   1:14   1:13   4:12   2:10  
##  Median :3.325   Median :17.71   8:14                  5: 5   3: 3  
##  Mean   :3.217   Mean   :17.85                                4:10  
##  3rd Qu.:3.610   3rd Qu.:18.90                                6: 1  
##  Max.   :5.424   Max.   :22.90                                8: 1
```

correlation matrix package

```
#install.packages("corrplot")
library(corrplot)
corMat <- cor(mtcars[,1:6])
corrplot(corMat, method="number")
```




```
corrplot.mixed(corMat, lower="square", upper="number",
               order = "hclust", tl.col="black")
```



1. marginal distribution
2. level

marginal distribution( )

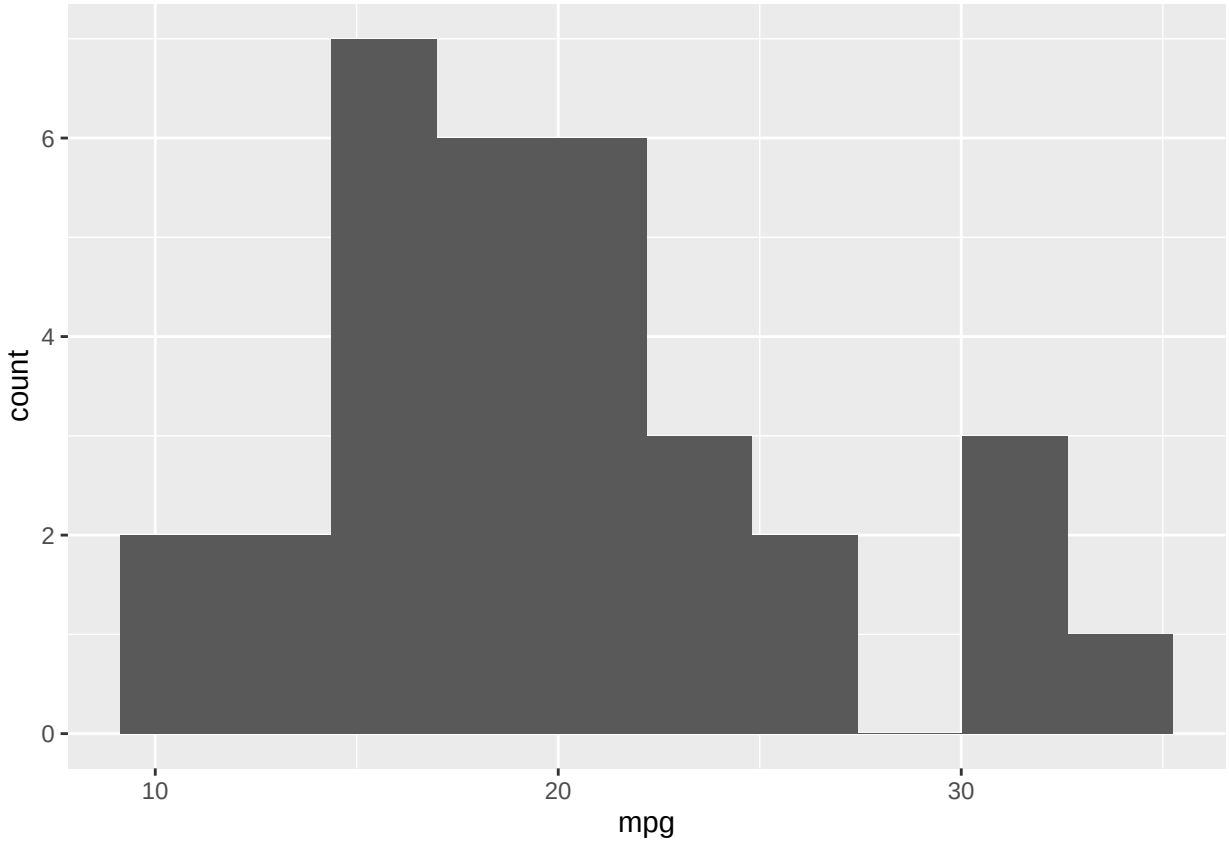
distribution

1. histogram
2. density
3. boxplot

`mtcars` `mpg(miles per gallon)`
mpg distribution

1. histogram

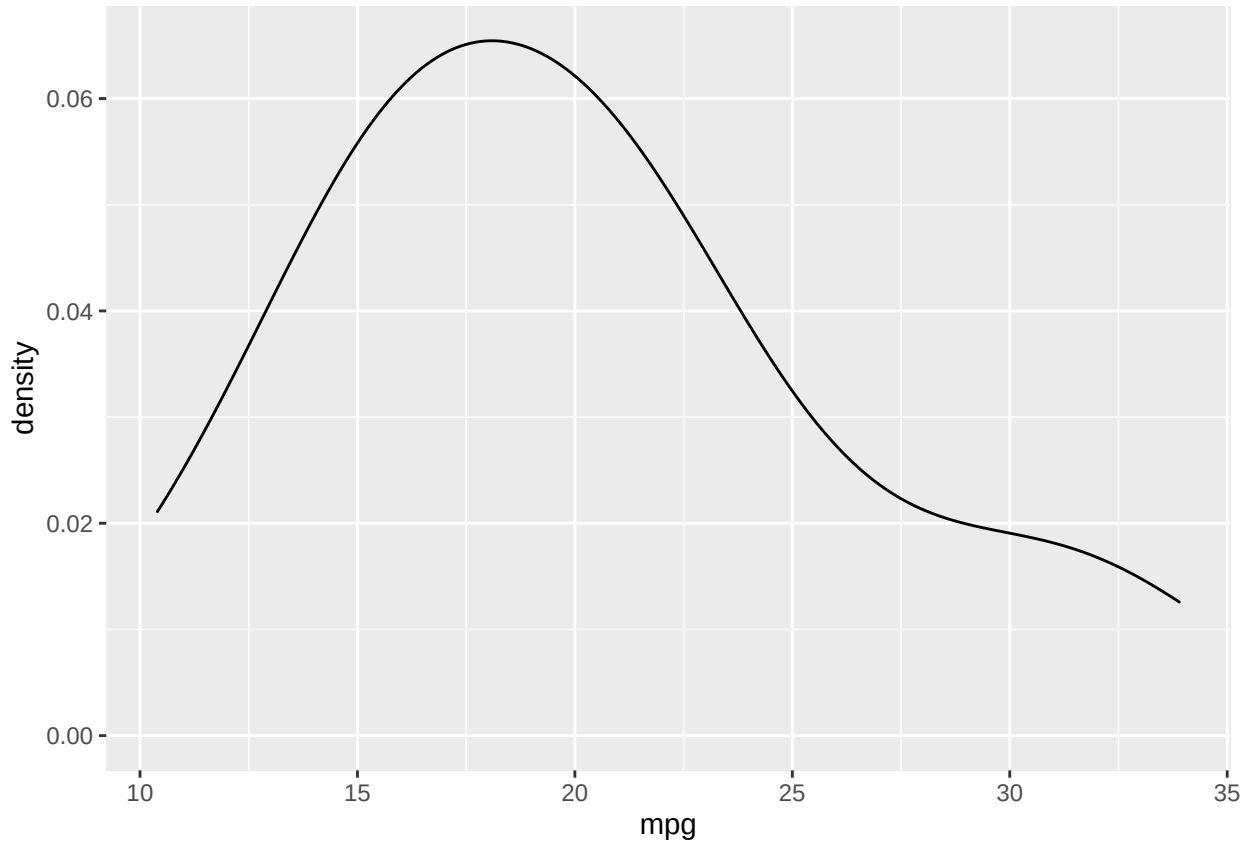
```
ggplot(mtcars, aes(mpg)) +
  geom_histogram(bins=10) #bins       30
```




```
  #geom_histogram(binwidth=3) + #binwidth
```

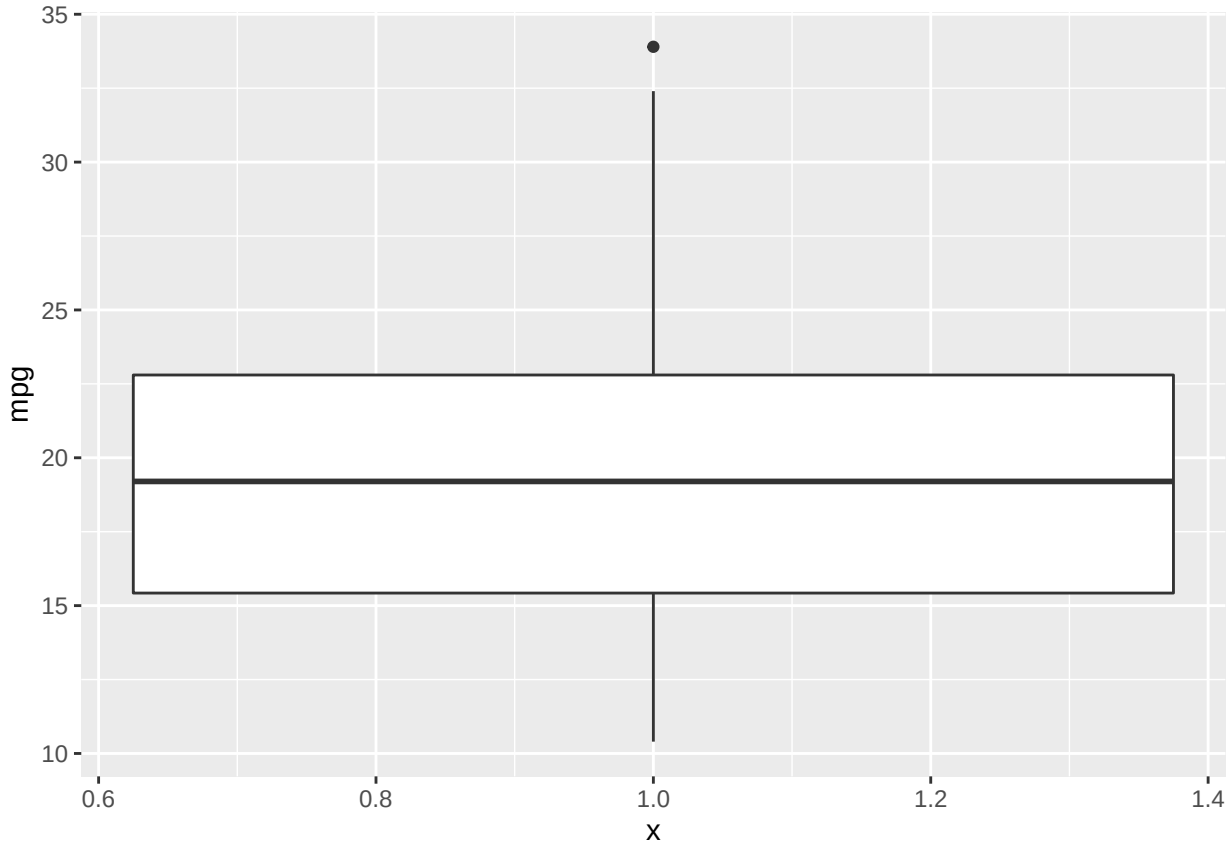
2. density

```
ggplot(mtcars, aes(mpg)) +
  geom_density(bw=3) #bw bandwith
```



3. box-plot

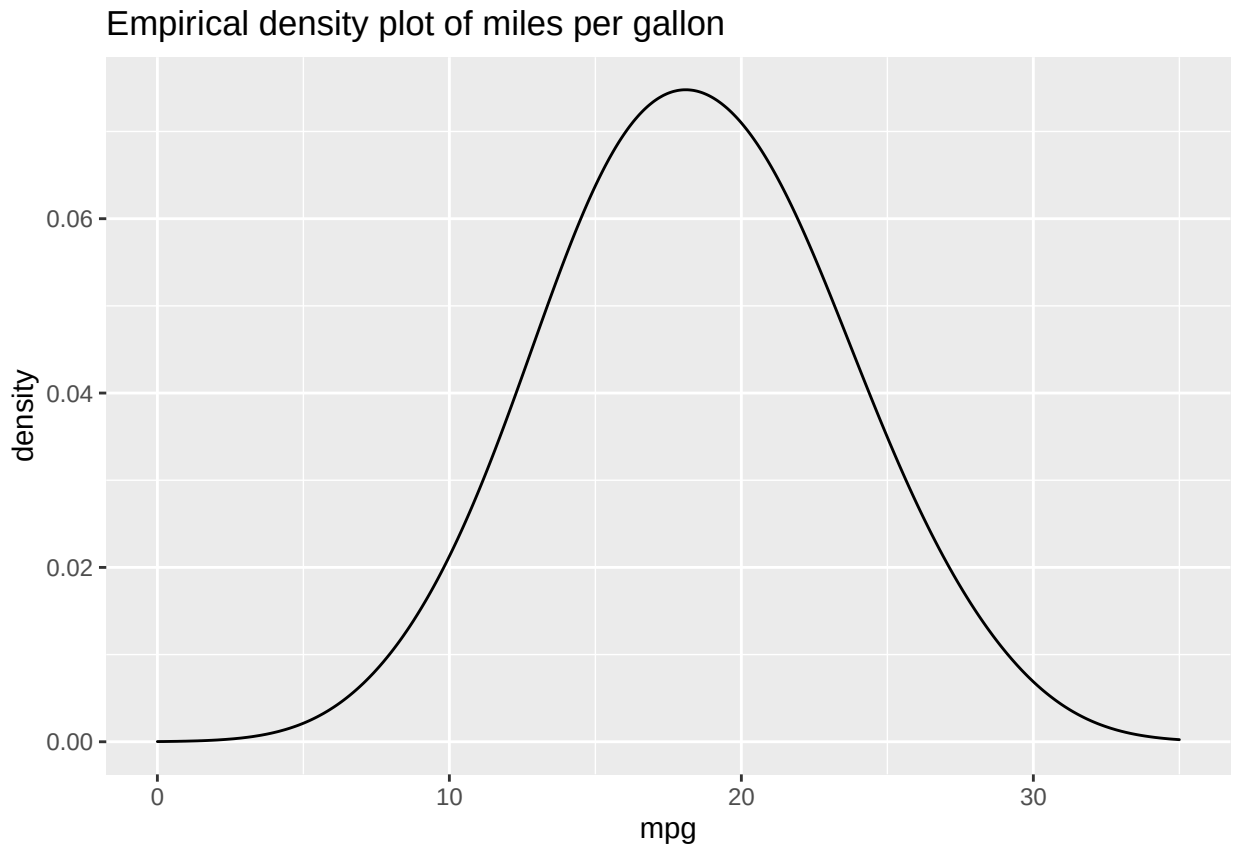
```
ggplot(mtcars, aes(x = 1, y = mpg))+
        geom_boxplot()
```



4.

density boxplot outlier outlier distributino

```
mtcars %>%
        filter(mpg < 30) %>%
        ggplot(aes(mpg)) +
        geom_density(bw=3) + #bw bindwith
        xlim(0,35)+
        ggtitle("Empirical density plot of miles per gallon")
```



marginal distribution( )

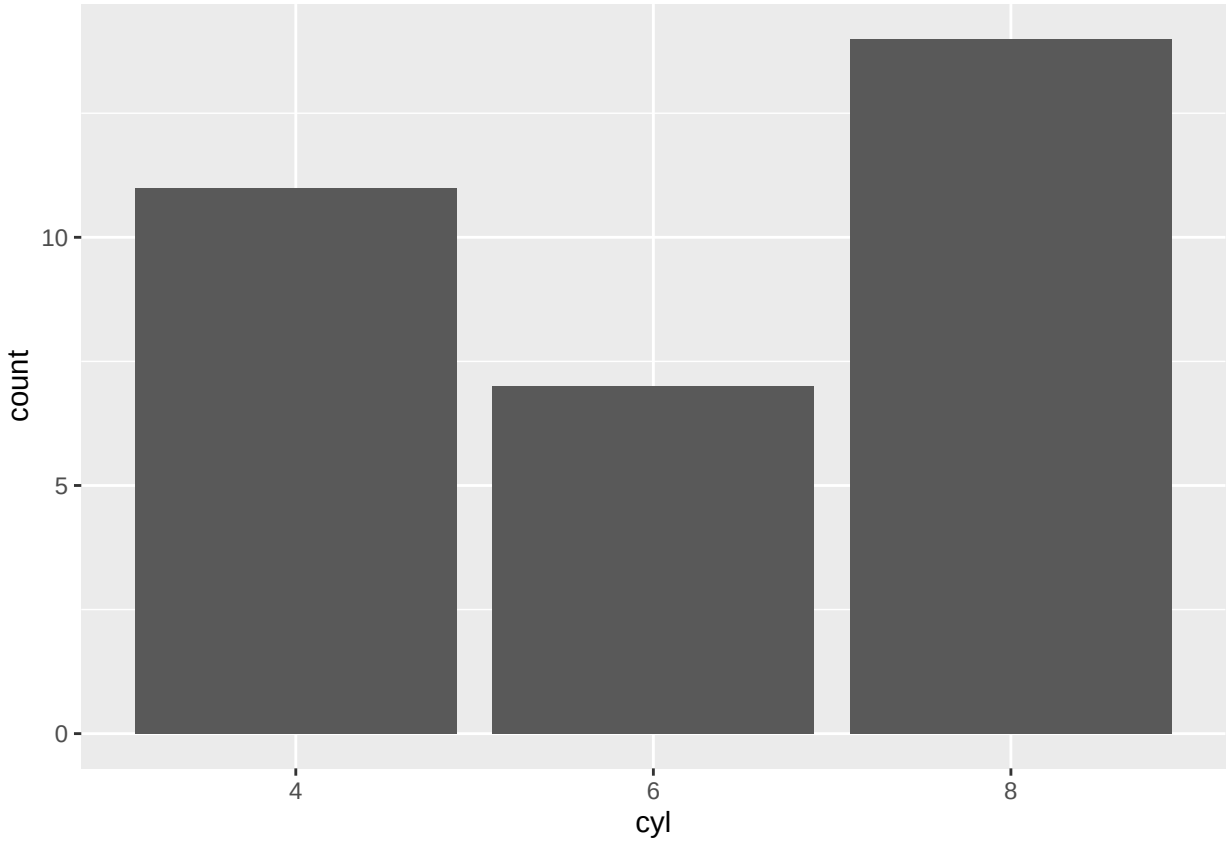
distribution

1. bar chart
2. pie chart ( )

`mtcars cyl(Number of cylinders)`
cyl distribution

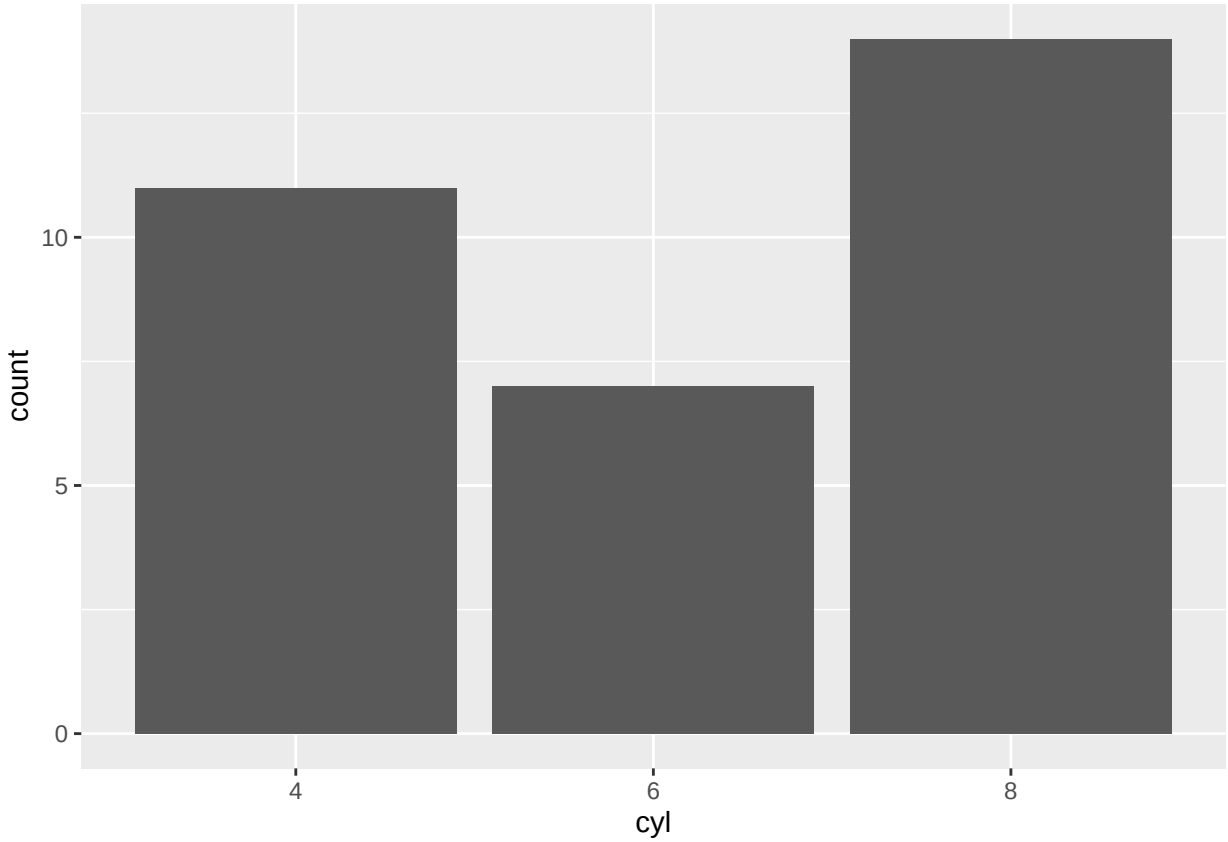
1. bar chart

```
ggplot(mtcars, aes(cyl))+
        geom_bar()
```




```
   aes(y=)
 geom_bar()  geom_bar(stat="count")
    count() count(cyl)
( ?gemo_bar)
```

```
ggplot(mtcars, aes(cyl))+
       geom_bar(stat="count")
```




```
# stat = "identity" <- height of the bars to represent values in the data
```

stat stat="identity"

```
ggplot(mtcars, aes(cyl))+
        geom_bar(stat="identity")
```

ggplot geom_bar
dplyr + ggplot2

dplyr: count()

```
count(mtcars, cyl)
```

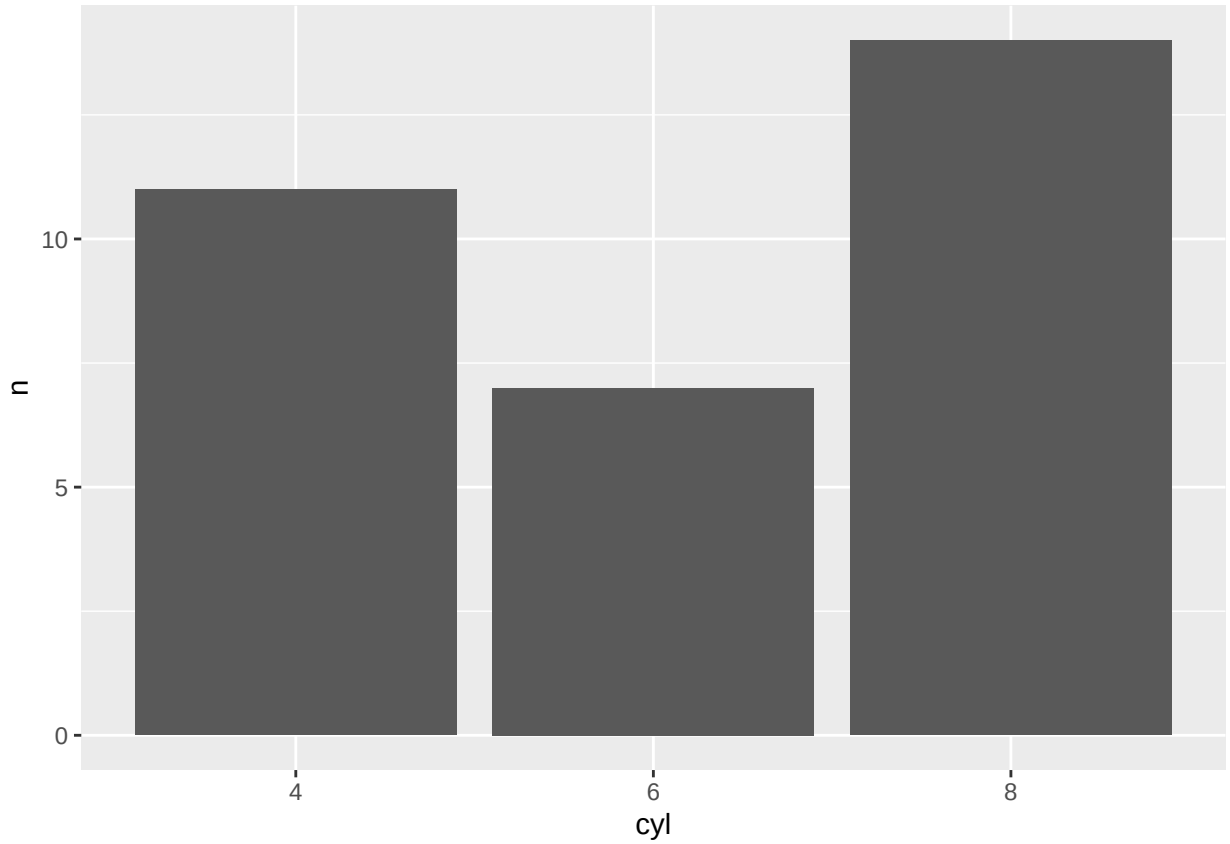
```
## # A tibble: 3 x 2
##   cyl       n
##   <fct> <int>
## 1 4        11
## 2 6         7
## 3 8        14
```

geom_bar(stat="count")

dplyr data.frame ggplot

```
mtcars %>%
        count(cyl) %>%
        ggplot(aes(x=cyl, y=n))+
```

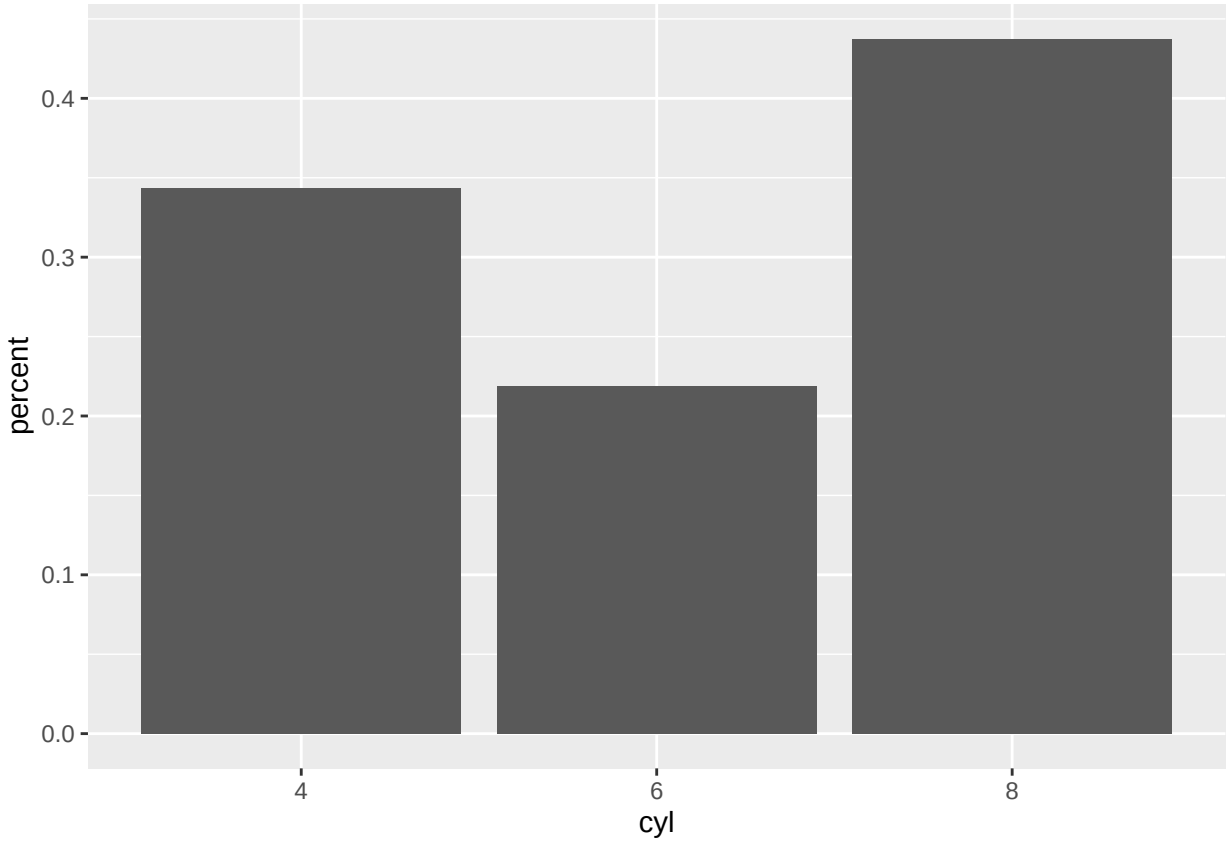
```
        geom_bar(stat="identity")
```




```
        # geom_bar() error why?
```

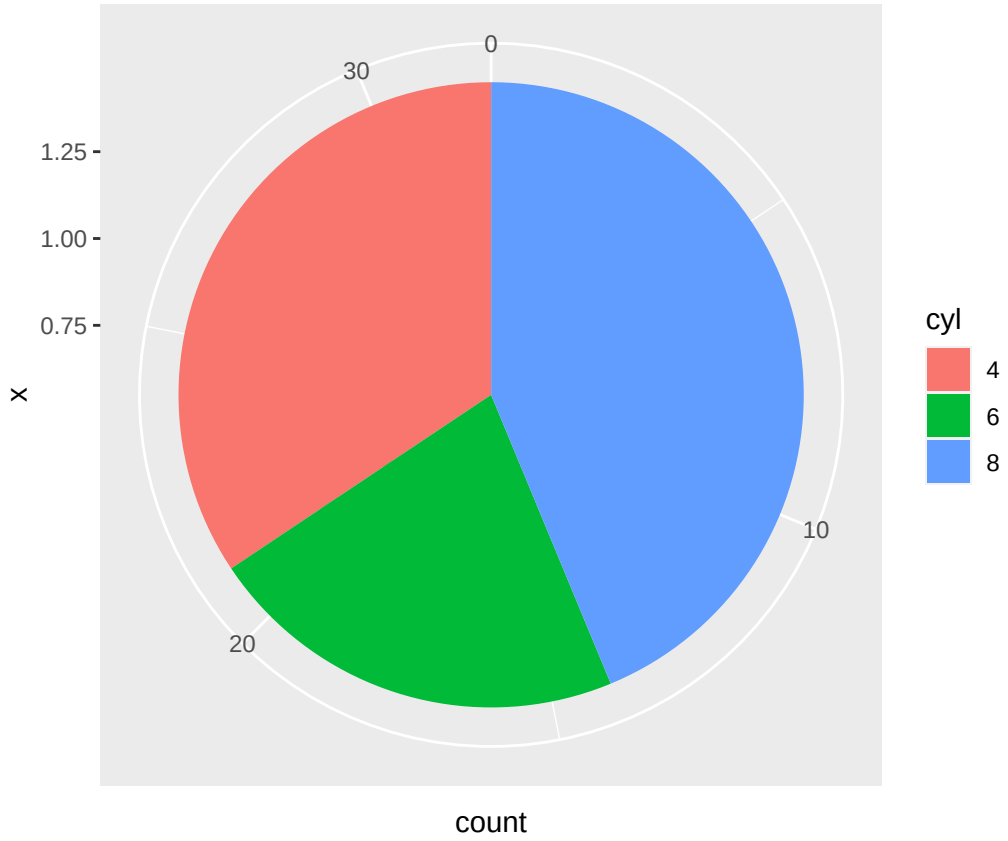
y “ ” “ ”

```
mtcars %>%
        count(cyl) %>%
        mutate(percent=n/sum(n)) %>%
        ggplot(aes(x = cyl, y = percent))+
        geom_bar(stat="identity")
```



2. pie chart ( )

```
ggplot(mtcars, aes(x=1, fill=cyl))+
        geom_bar()+
        coord_polar(theta="y")
```

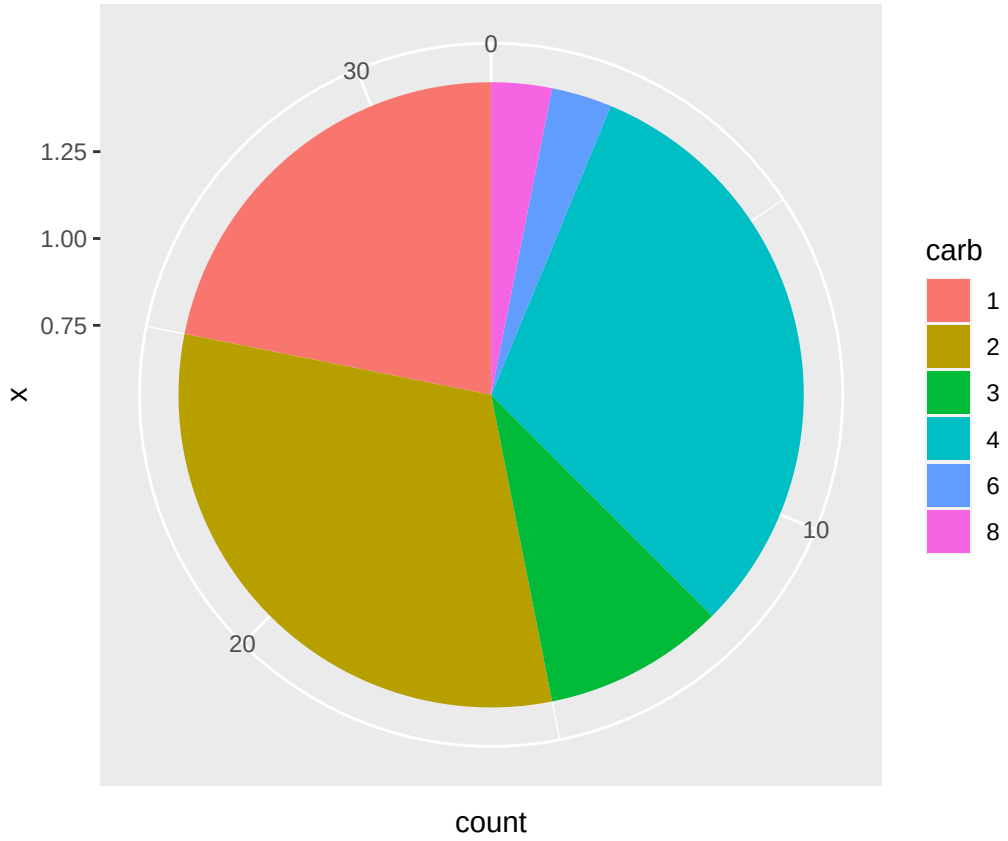


pie chart

Pie Chart bar chart

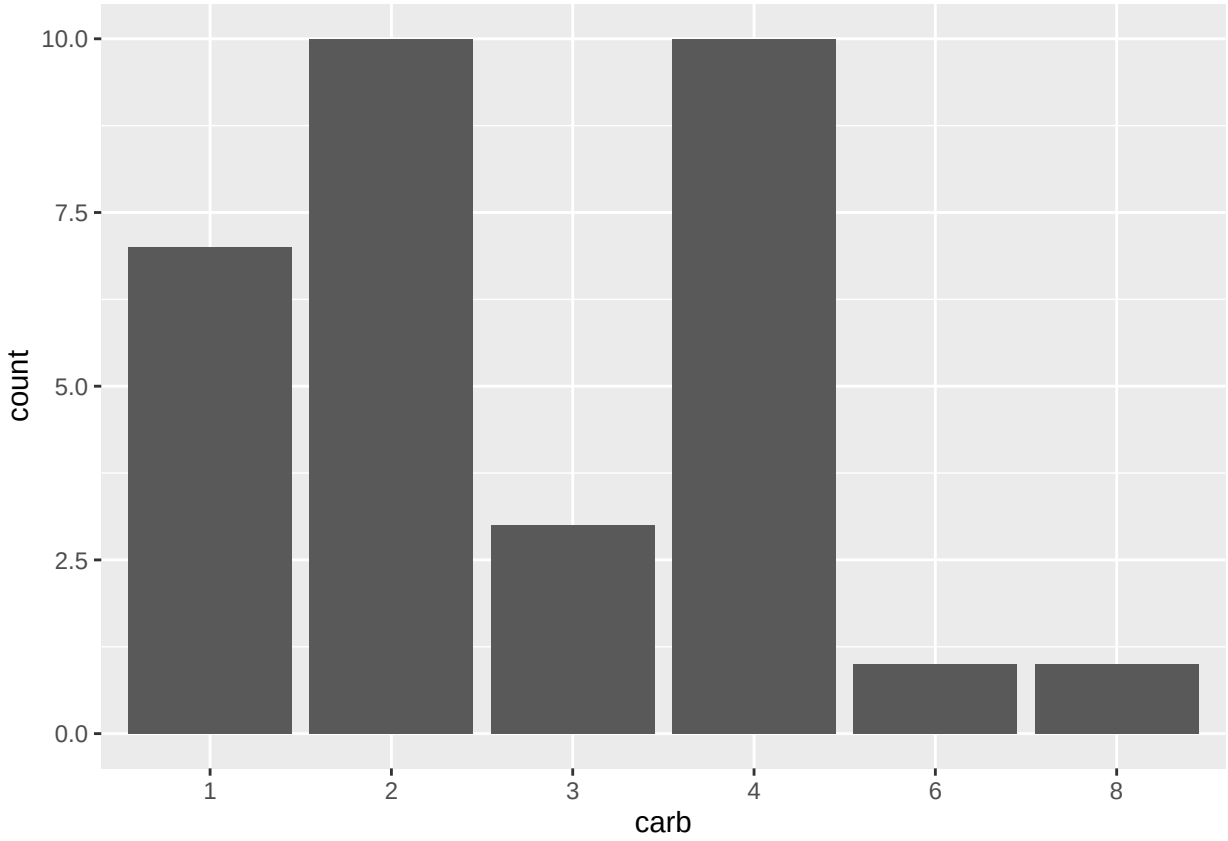
Pie Chart >3

```
ggplot(mtcars, aes(x=1, fill=carb))+
        geom_bar()+
        coord_polar(theta="y")
```



carb( )=1, 2, 4
=6, 8
Pie Chart bar chart

```
ggplot(mtcars, aes(carb))+
        geom_bar()
```



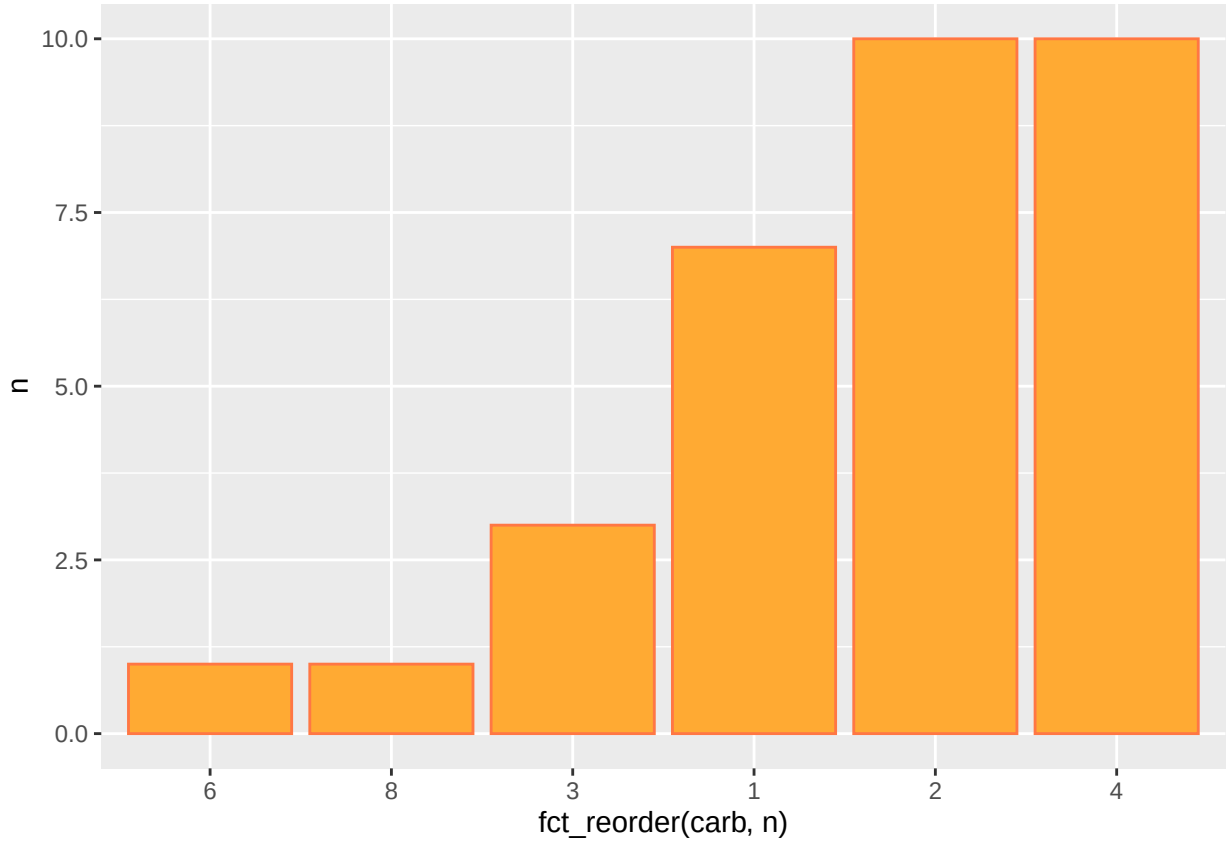
level

care level

1. bar chart
2. scatter plot
3. Cleveland Dot plot

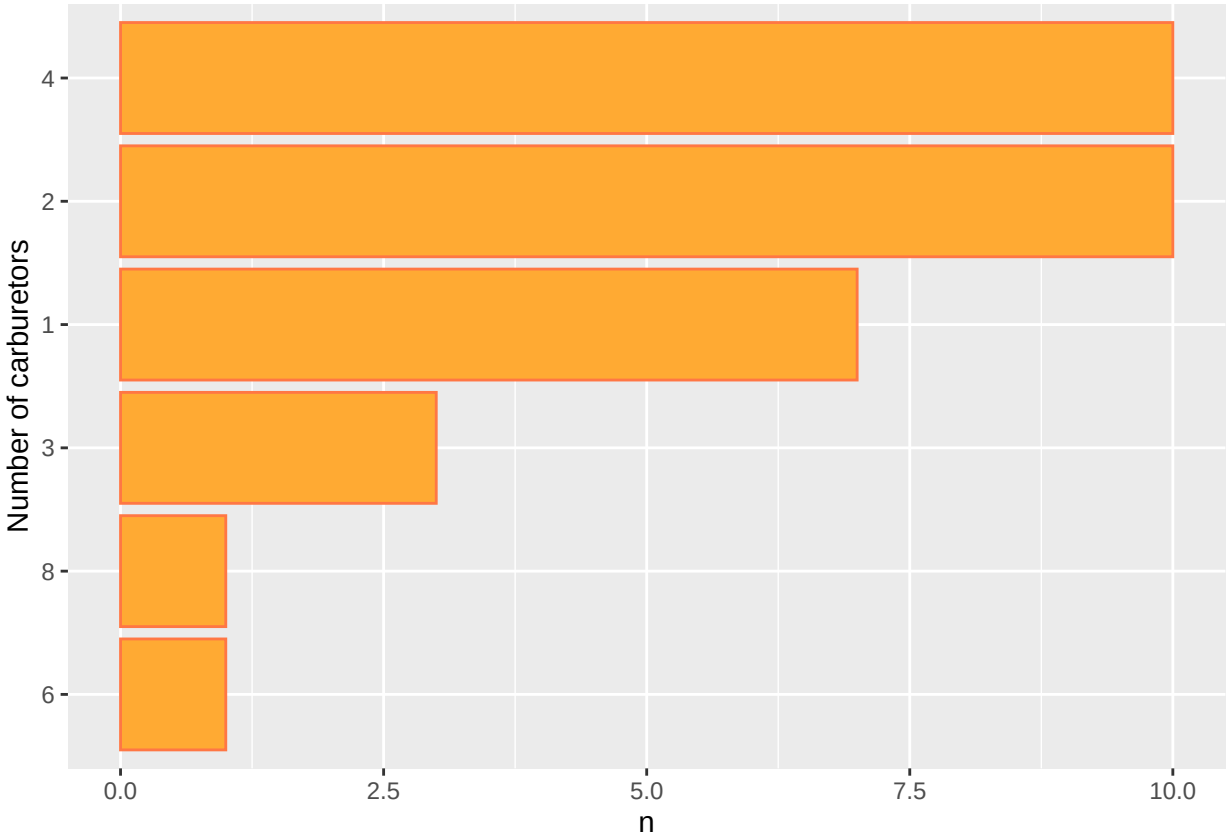
    1. barchart

```
mtcars %>%
        count(carb) %>%
        ggplot(aes(x = fct_reorder(carb,n), y = n))+
        geom_bar(col = "#FF7744", fill = "#FFAA33", stat="identity")
```



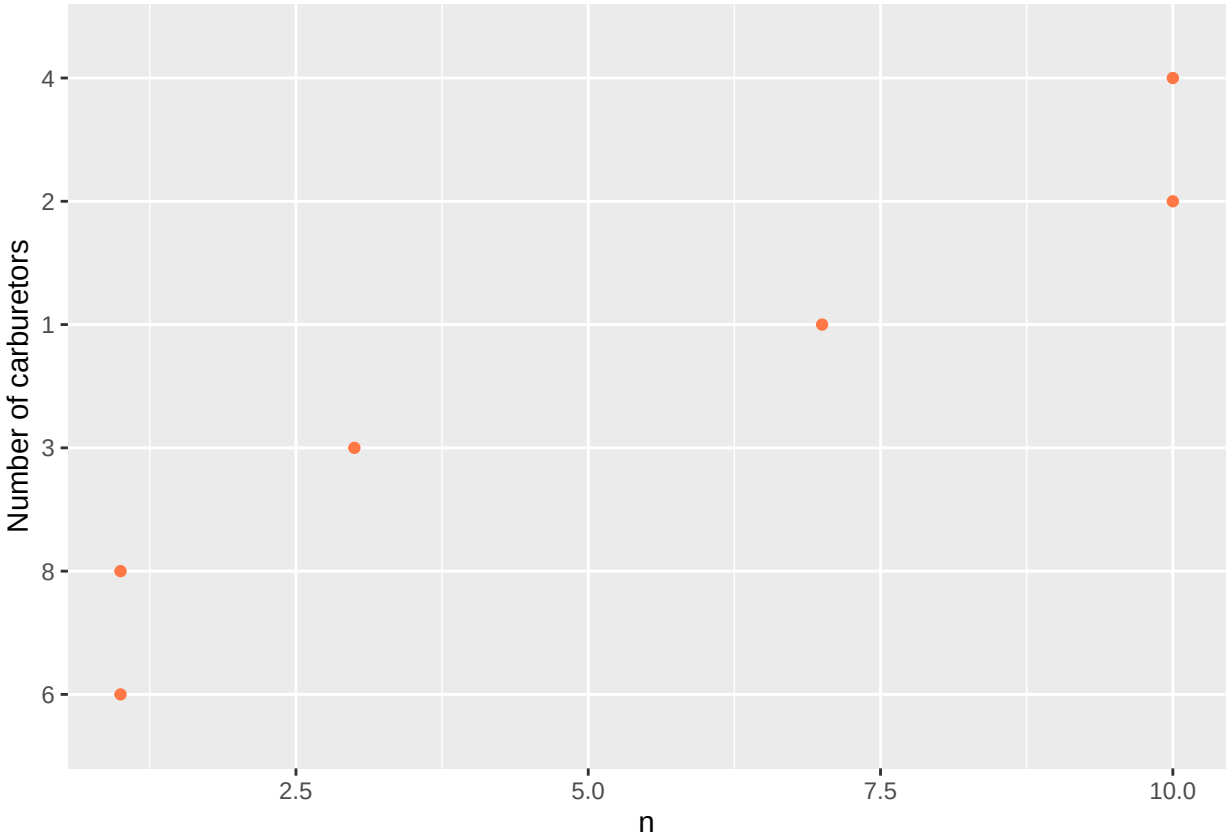
label &

```
mtcars %>%
        count(carb) %>%
        ggplot(aes(x=fct_reorder(carb,n),y=n))+
        geom_bar(col = "#FF7744", fill = "#FFAA33", stat="identity")+
        labs(x="Number of carburetors")+
        coord_flip()
```



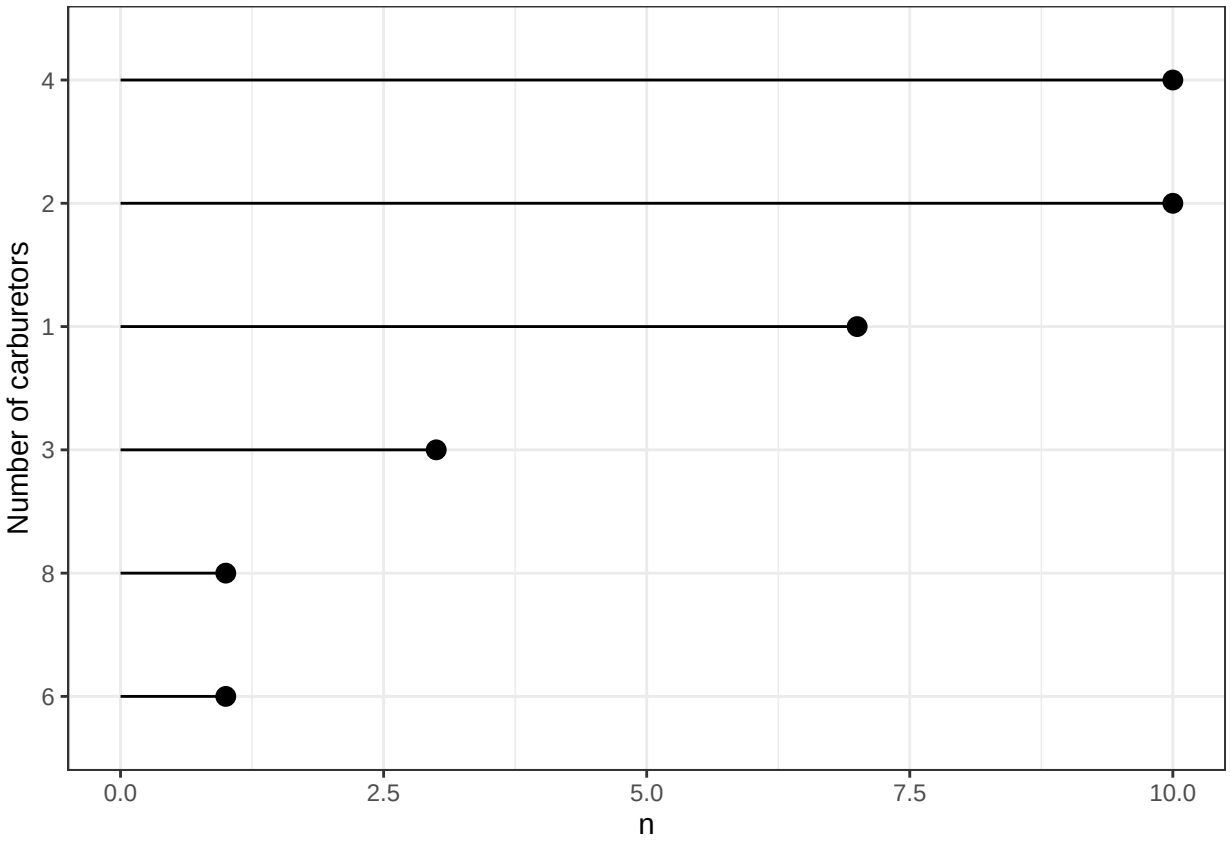
2. scatter plot

```
mtcars %>%
        count(carb) %>%
        ggplot(aes(x=n, y=fct_reorder(carb,n)))+
        geom_point(col = "#FF7744", fill = "#FFAA33")+
        labs(y="Number of carburetors")
```



3. Cleveland Dot plot

```
mtcars %>%
        count(carb) %>%
        ggplot(aes(x=n, y=fct_reorder(carb,n)))+
        geom_point(size=3)+
        geom_segment(aes(xend=0,yend=carb))+
        labs(y="Number of carburetors")+
        theme_bw()
```



wrap up

```
#histogram
ggplot(mtcars, aes(mpg)) +
        geom_histogram(bins=10)

#density
ggplot(mtcars, aes(mpg)) +
        geom_density(bw=3)

#box-plot
ggplot(mtcars, aes(x=1, y=mpg))+
        geom_boxplot()

#bar chart ( )
ggplot(mtcars, aes(cyl))+
        geom_bar()

#bar chart ( )
mtcars %>%
        count(cyl) %>%
        ggplot(aes(x=cyl, y=n))+
        geom_bar(stat="identity")

#bar chart (y   )
```

```
mtcars %>%
        count(cyl) %>%
        mutate(percent=n/sum(n)) %>%
        ggplot(aes(x=cyl, y=percent))+
        geom_bar(stat="identity")

#bar chart (reorder levels)
mtcars %>%
        count(carb) %>%
        ggplot(aes(x=fct_reorder(carb,n),y=n))+
        geom_bar(stat="identity")

#
coord_flip() #
labs(x=" ", y=" ") # x , y
```

1. comparison
2. relationship

comparison(|)

given conditional distribution
3

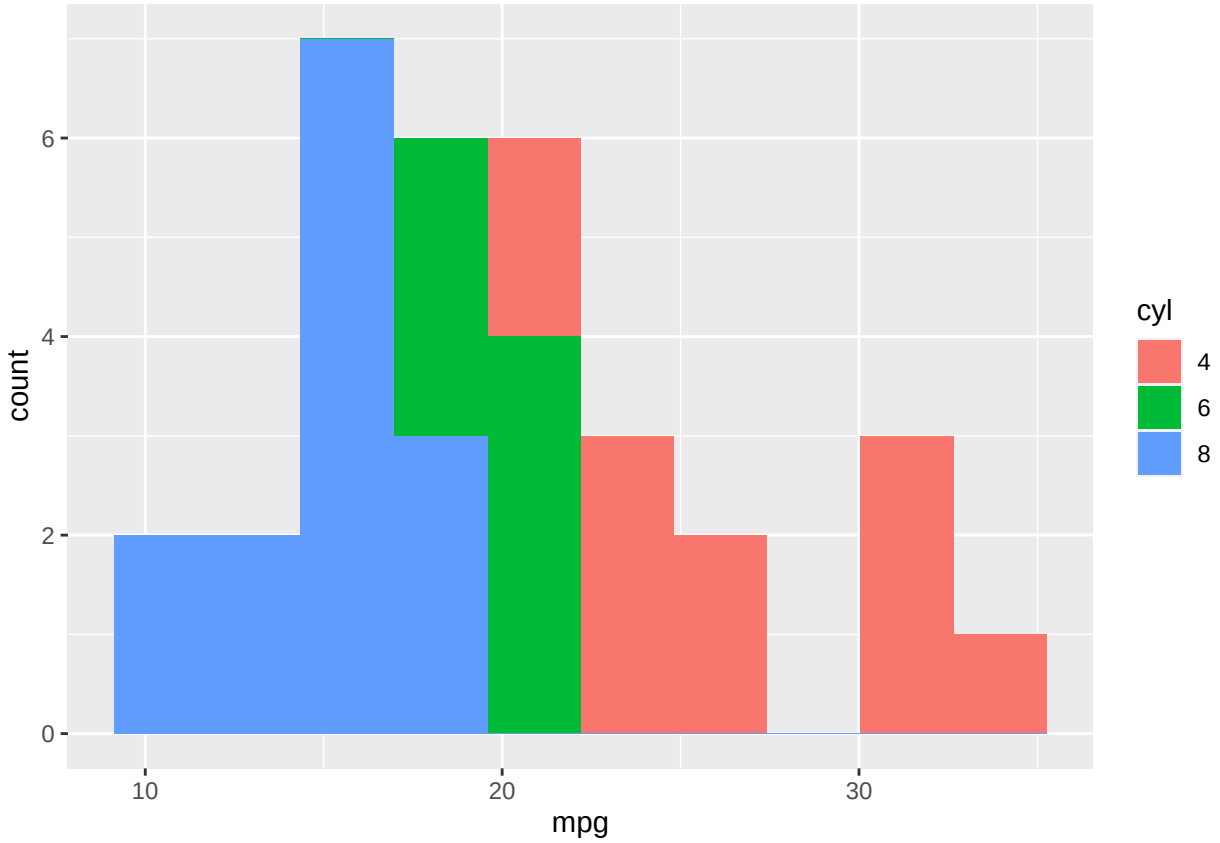
1. histogram / frequency plot / density
2. facet histogram / frquency plot / density
3. side by side box plot

`mtcars` (mpg) (cyl)

Note:
`mpg`: miles per gallon `cyl`: 4, 6, 8 levels

1.1 histogram ( )

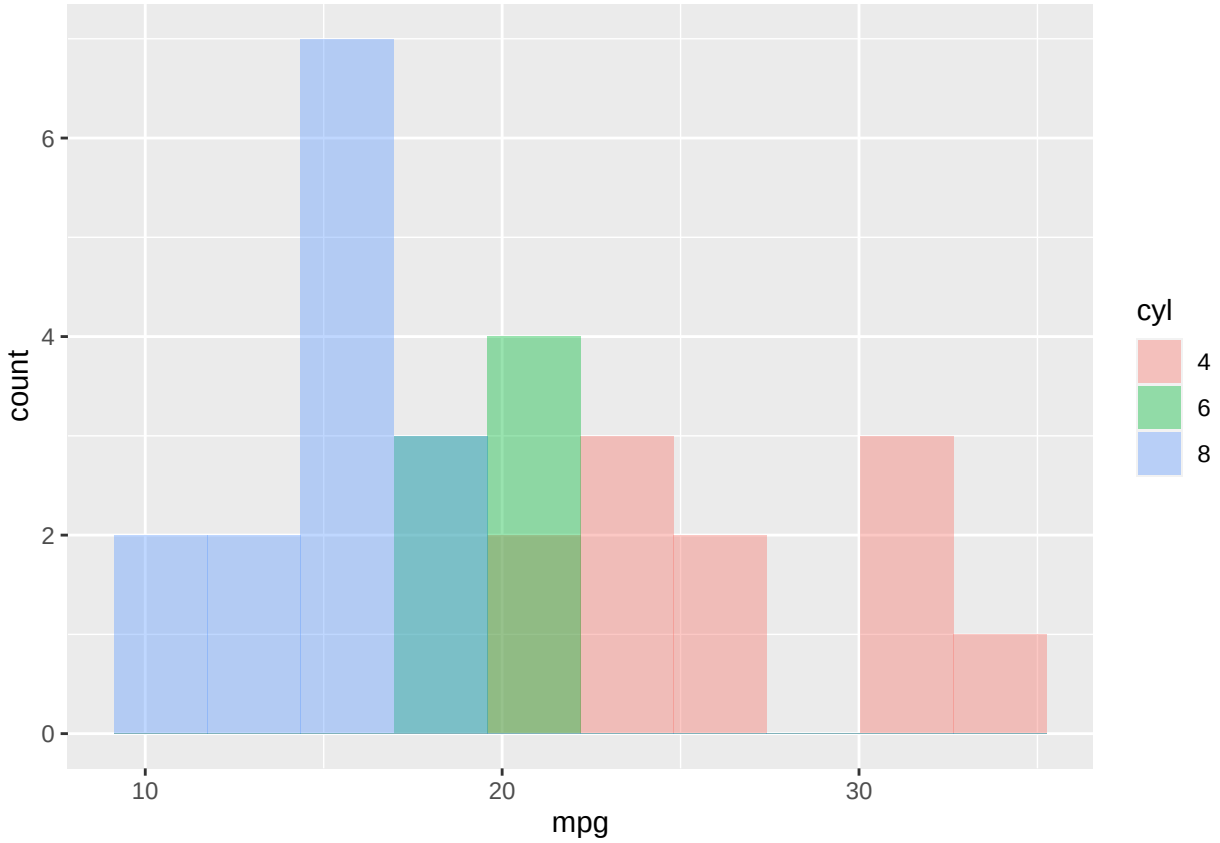
```
ggplot(mtcars, aes(x=mpg, fill=cyl)) +
        geom_histogram(bins = 10)
```



default “idetity” alpha

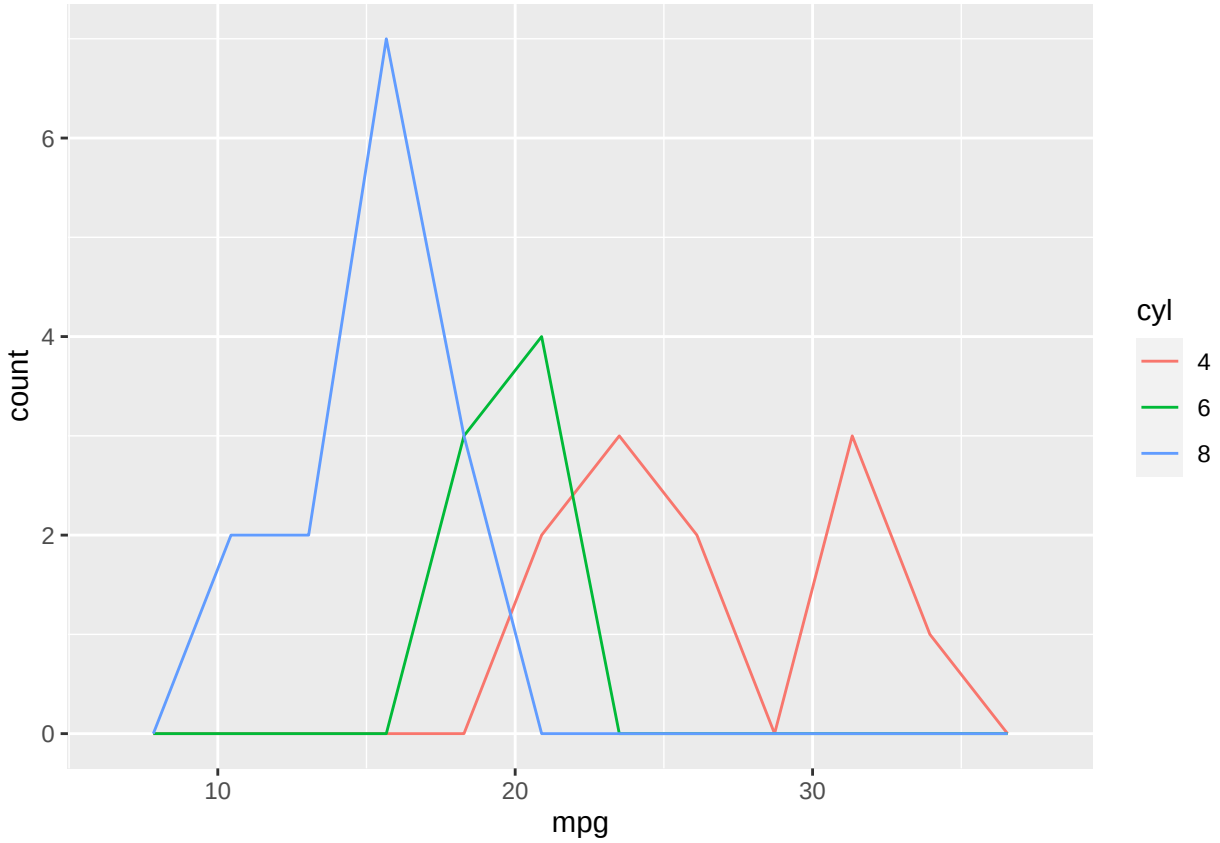
1.1 histogram ( )

```
ggplot(mtcars, aes(x=mpg,fill=cyl)) +
        geom_histogram(bins = 10,position="identity", alpha=0.4)
```



1.2 frequency plot

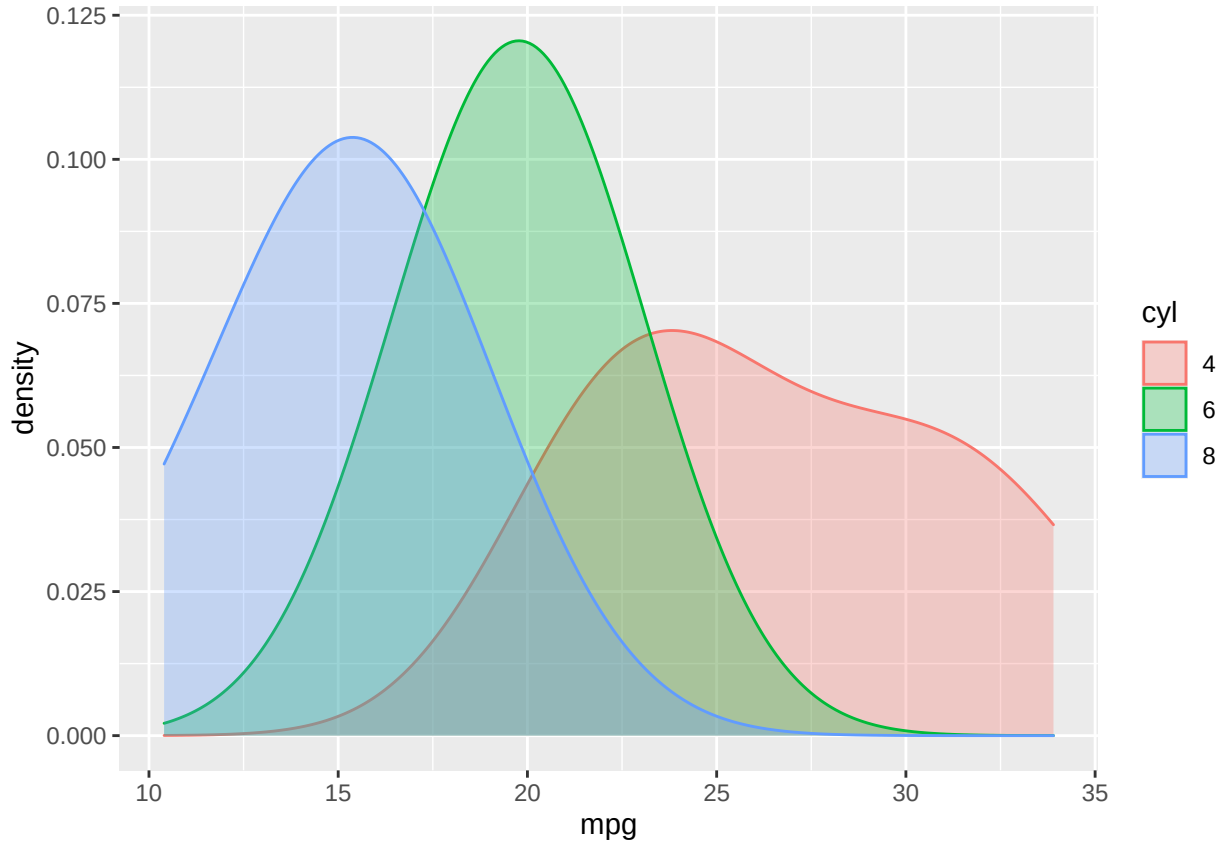
```
ggplot(mtcars, aes(x=mpg, col=cyl)) +
        geom_freqpoly(bins=10)
```



aes() fill col fill

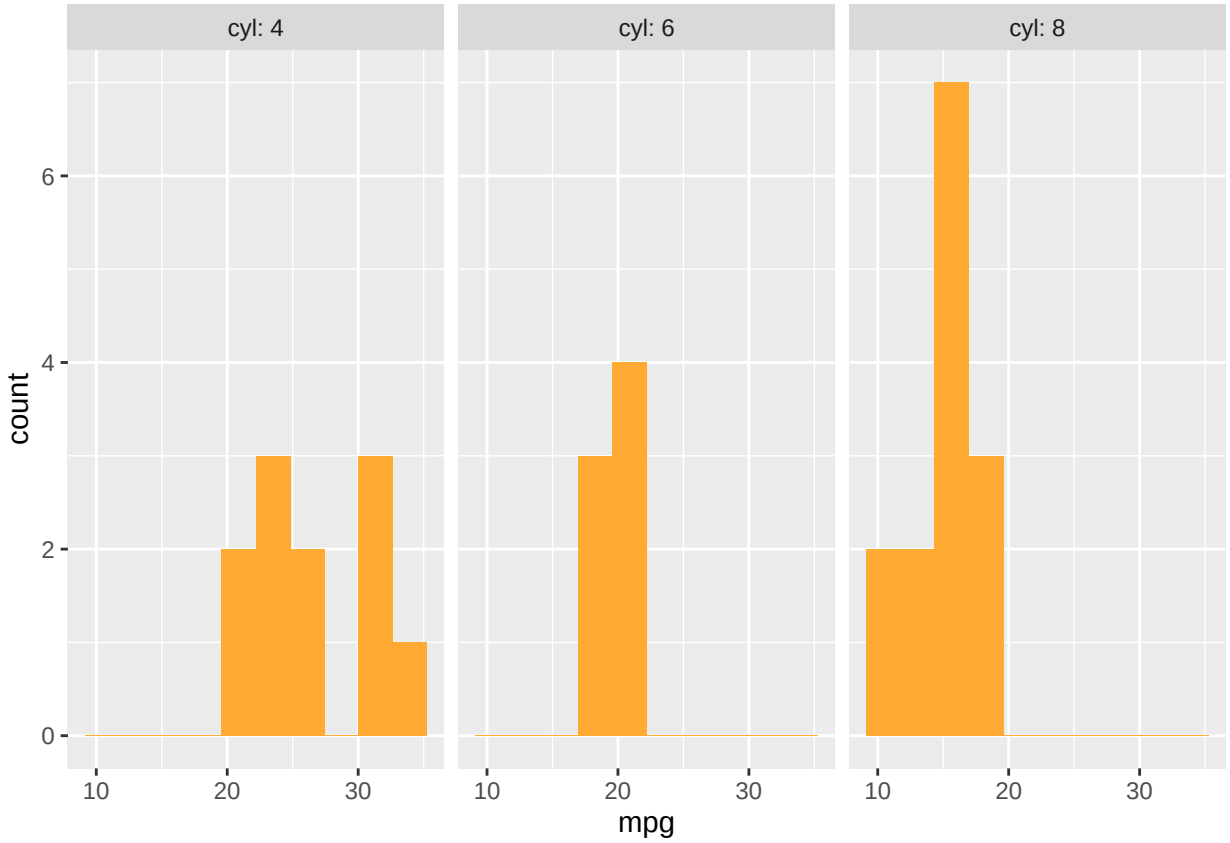
1.3 density

```
ggplot(mtcars, aes(x = mpg, col = cyl, fill = cyl)) +
        geom_density(bw=3, alpha = 0.3)
```



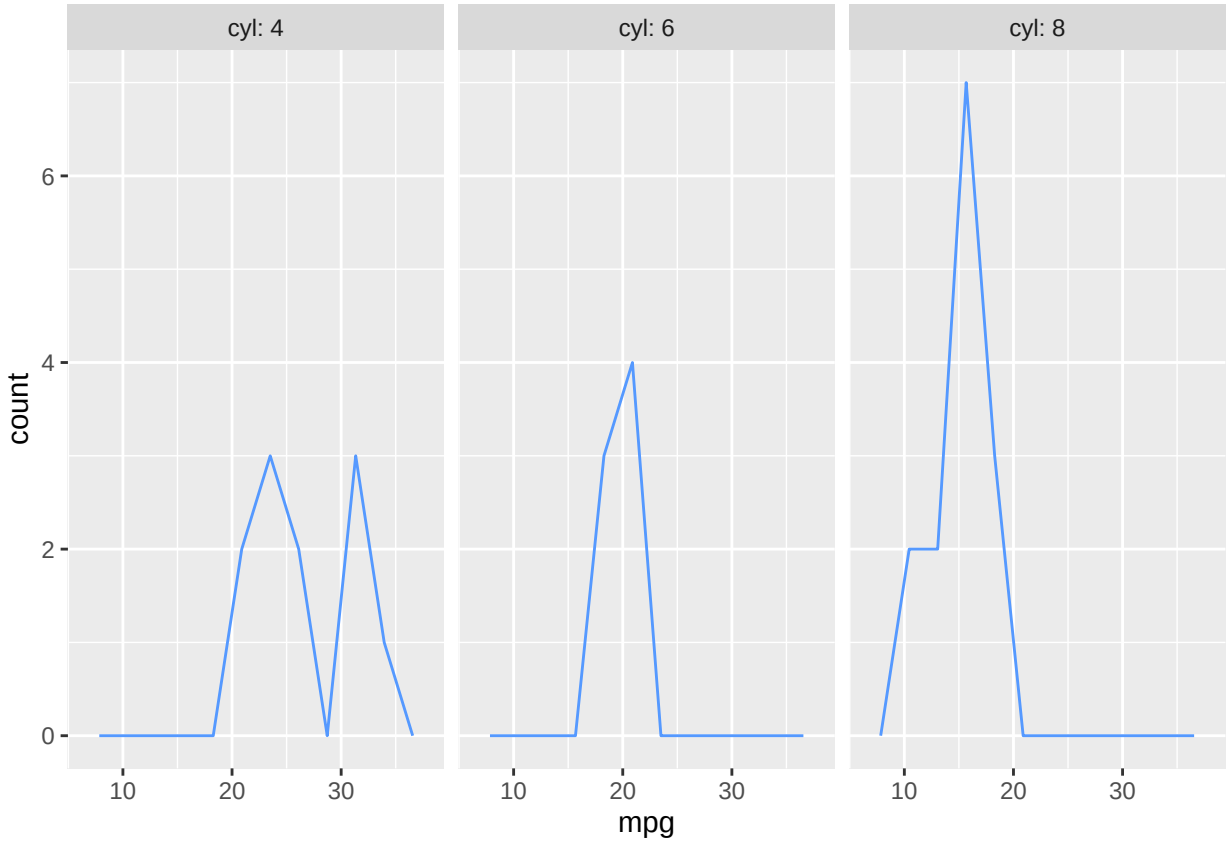
2.1 facet histogram

```
ggplot(mtcars, aes(x=mpg)) +
        geom_histogram(bins = 10,  fill = "#FFAA33")+
        facet_grid(~cyl, labeller = label_both)
```



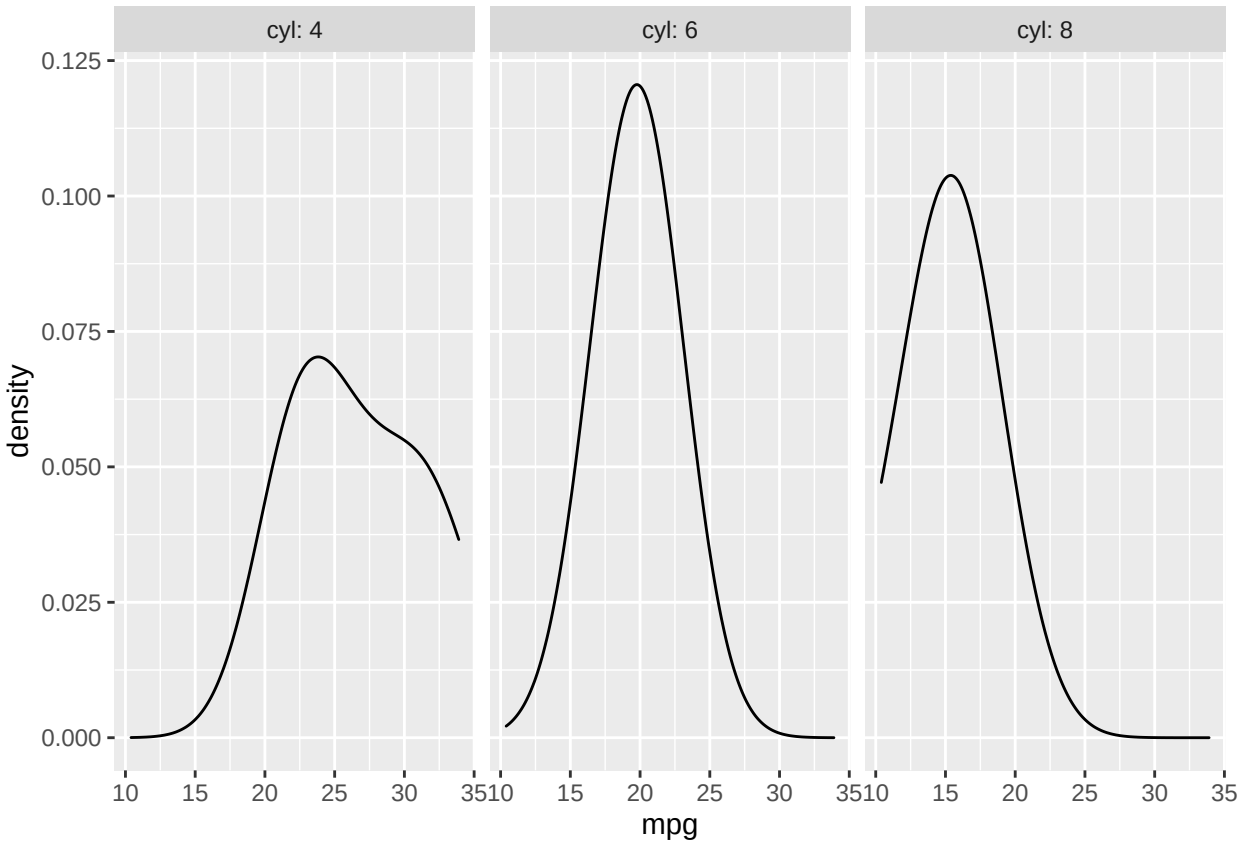
2.2 facet frquency plot

```
ggplot(mtcars, aes(x=mpg))+
        geom_freqpoly(bins=10,  col = "#5599FF")+
        facet_grid(~cyl, labeller = label_both)
```



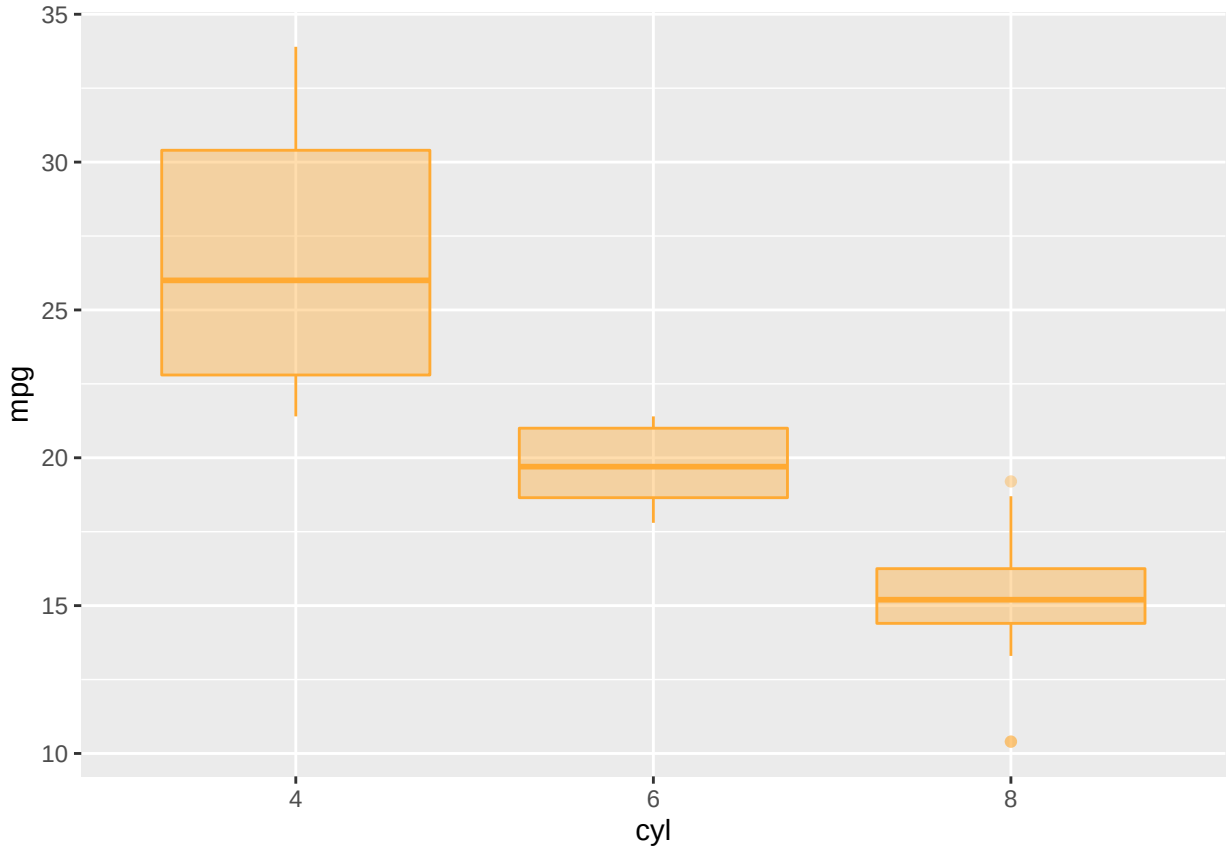
2.3 facet density

```
ggplot(mtcars, aes(x=mpg))+
        geom_density(bw=3)+
        facet_grid(~cyl, labeller=label_both)
```



3. side-by-side box plot

```
ggplot(mtcars, aes(x = cyl, y = mpg)) +
  geom_boxplot(col = "#FFAA33", fill = "#FFAA33", alpha = 0.4)
```




```
mtcars %>%
        group_by(cyl) %>%
        summarize(mpg_median=median(mpg))
```

```
## # A tibble: 3 x 2
##   cyl   mpg_median
##   <fct>      <dbl>
## 1 4           26
## 2 6           19.7
## 3 8           15.2
```

relationship(vs)

contingency table
given conditional distribution
(|) conditional distribution 2

0. contingency table & conditional probability table

1. conditional bar chart
2. facet bar chart

`mtcars` `cyl` `vc`

Note: `cyl`: 4, 6, 8 levels `vc` : levels: 0=v ; 1= domain knowledge: V6, v8, v10; 4 6

0.1 contingency table

```
tab1 <- table(mtcars$cyl, mtcars$vs)
tab1
```

```
##
##      0  1
##   4  1 10
##   6  3  4
##   8 14  0
```

0.2 conditional probability table

```
round(prop.table(tab1, 1),2)
```

```
##
##        0    1
##   4 0.09 0.91
##   6 0.43 0.57
##   8 1.00 0.00
```

```
round(prop.table(tab1, 2),2)
```

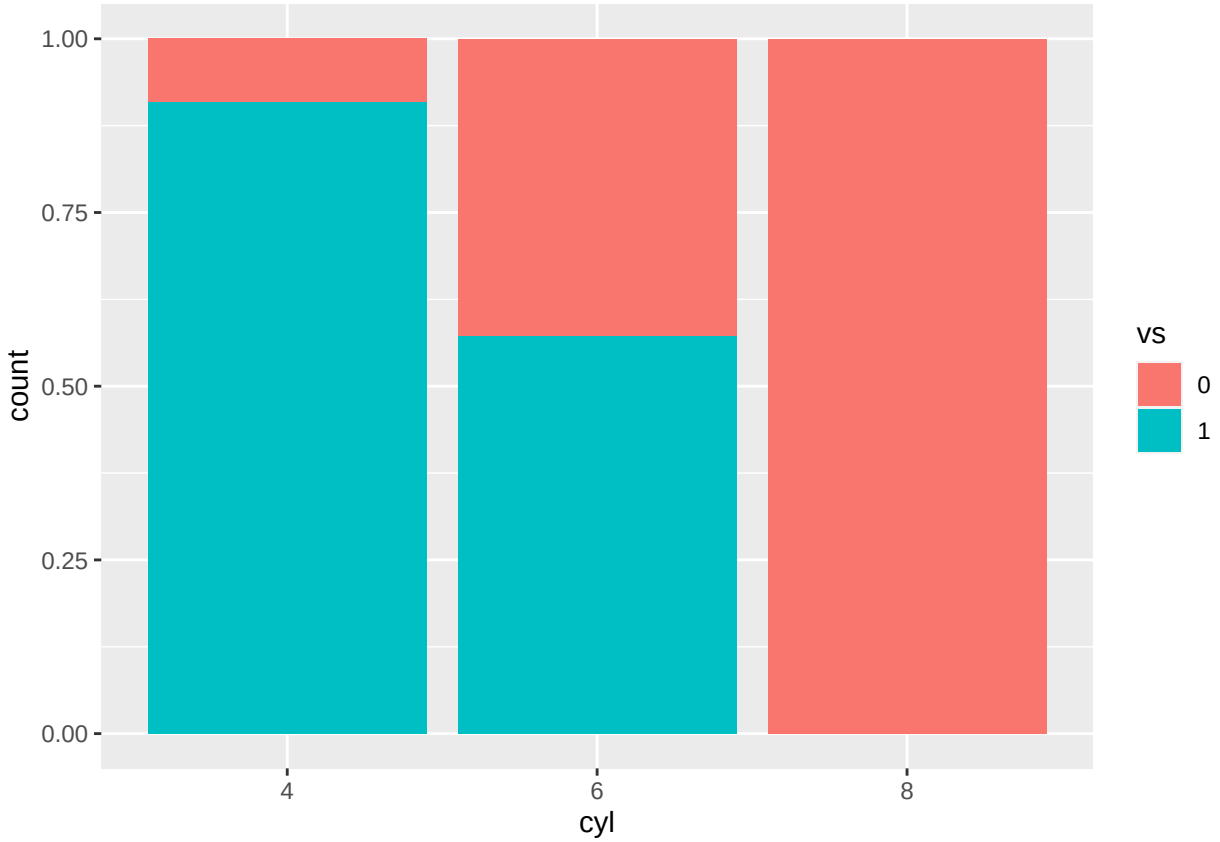
```
##
##        0    1
##   4 0.06 0.71
##   6 0.17 0.29
##   8 0.78 0.00
```

condition cyl distribution:

```
P(vs | cyl=4)     4       (91%)
P(vs | cyl=6)     6        (57%)
P(vs | cyl=8)     8    V
```

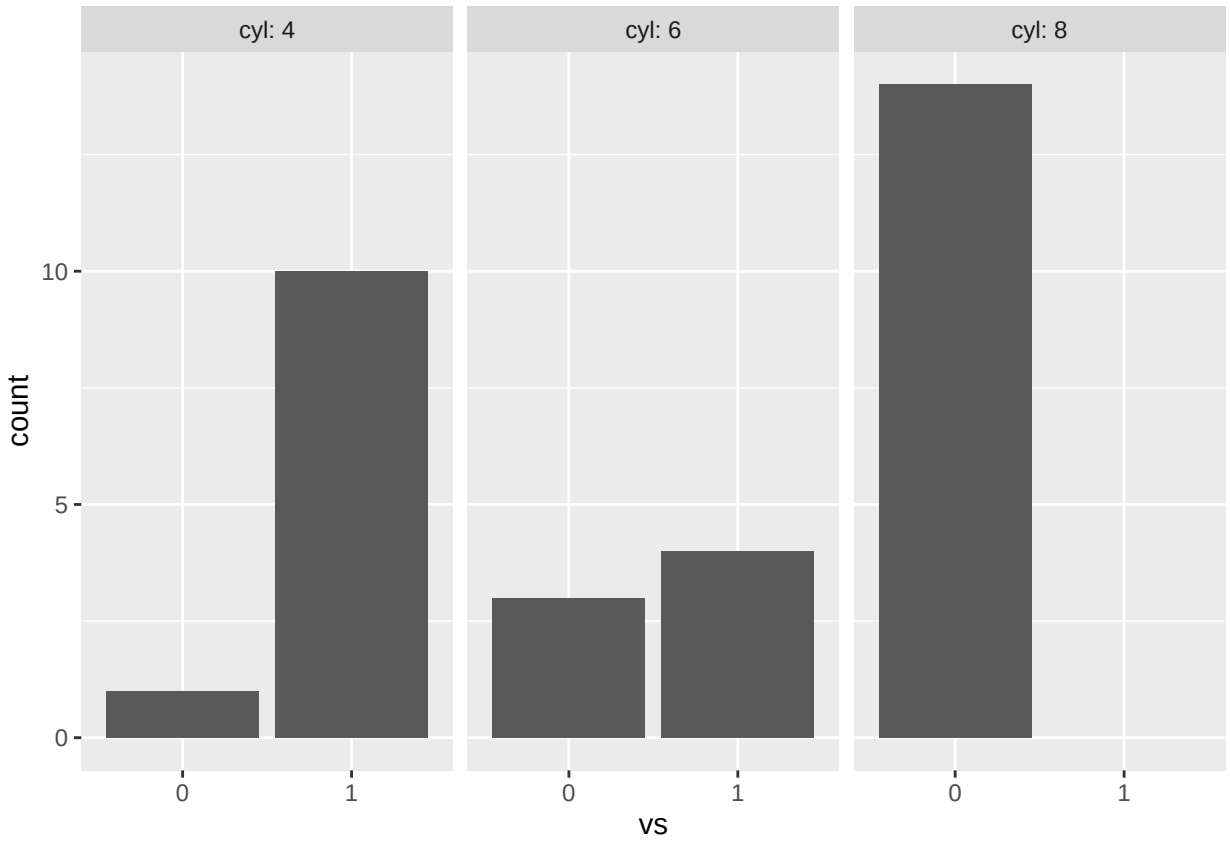
1. conditional bar chart

```
ggplot(mtcars, aes(x=cyl, fill=vs))+
       geom_bar(position="fill")
```



2. facet bar chart

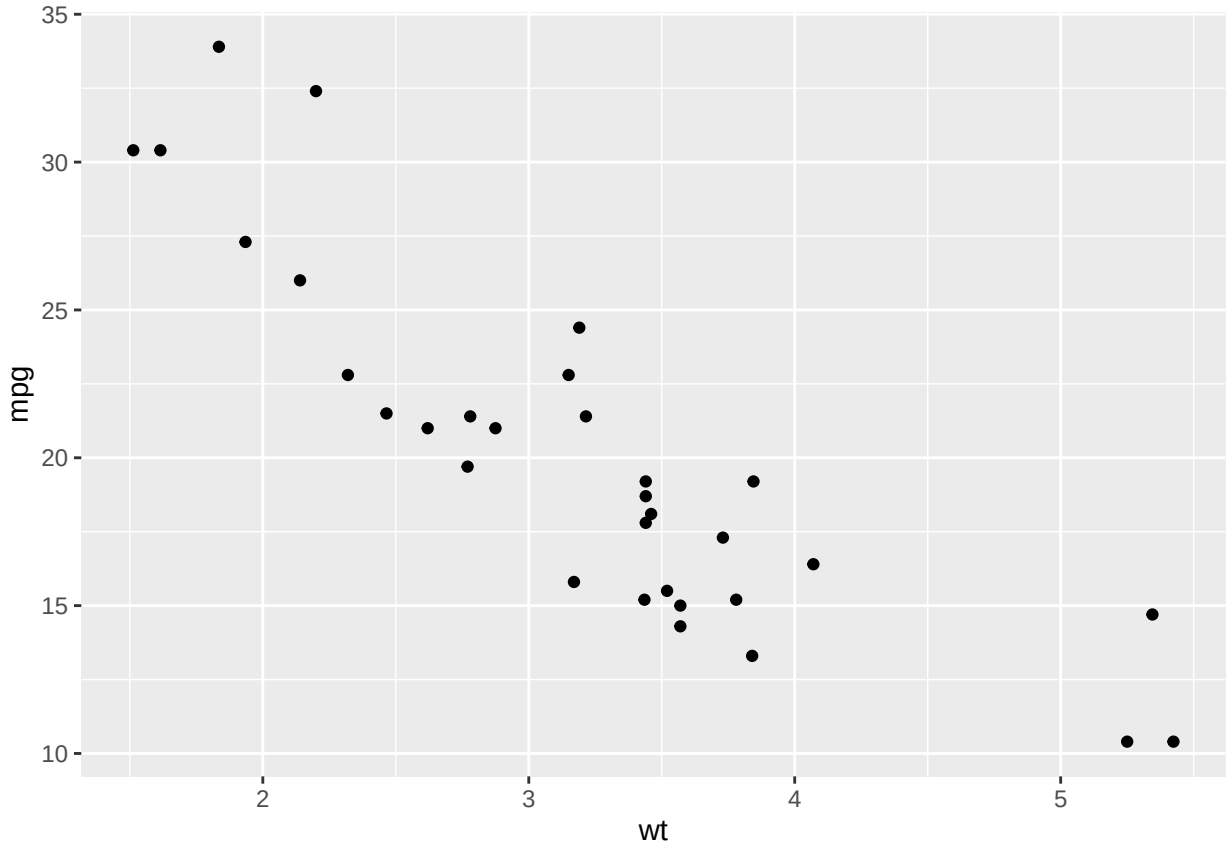
```
ggplot(mtcars, aes(x=vs))+
        geom_bar()+
        facet_grid(.~cyl, labeller = label_both)
```



relationship(vs)

scatter plot linear model
`mtcars` wt (weight) mpg ( ) relationship :

```
ggplot(mtcars, aes(x = wt, y = mpg)) +
  geom_point()
```

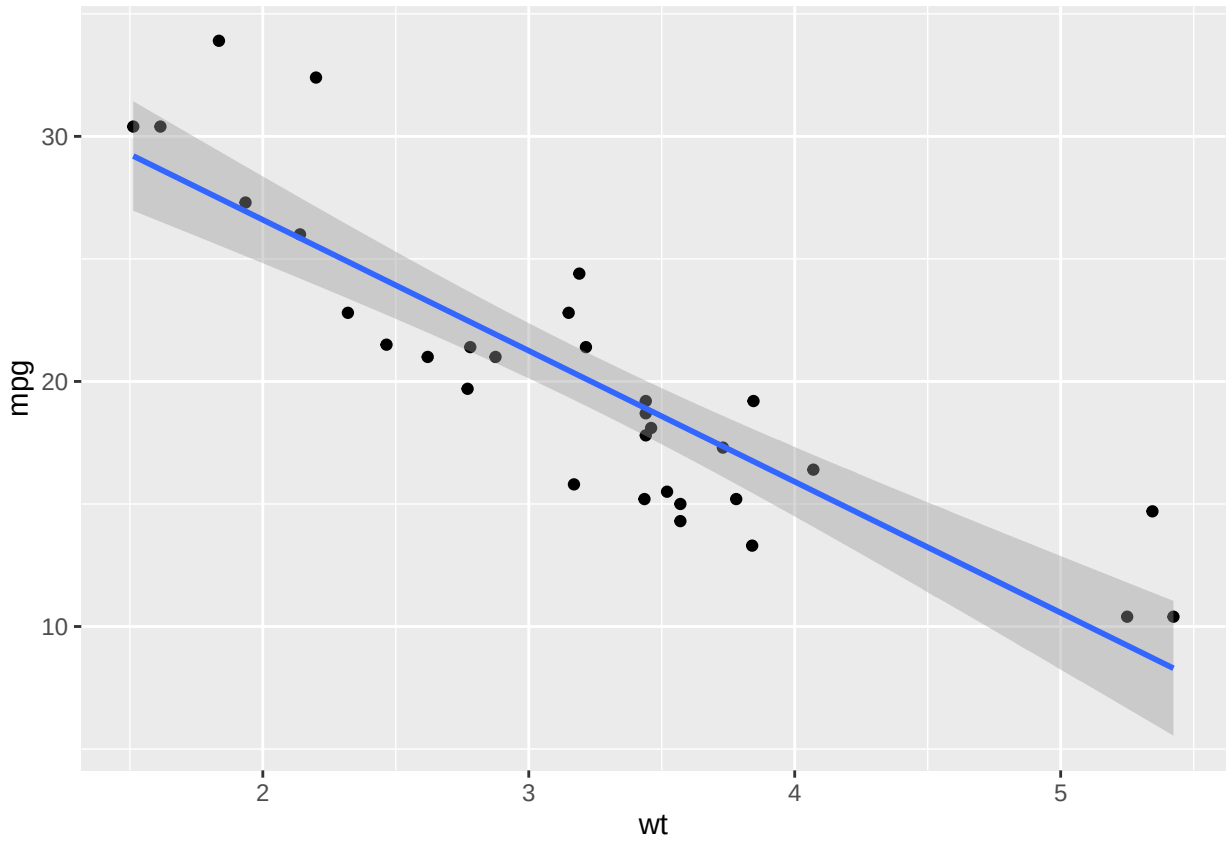


( )

correlation fit linear model

```
ggplot(mtcars, aes(x = wt, y = mpg)) +
  geom_point()+
  geom_smooth(method="lm")
```

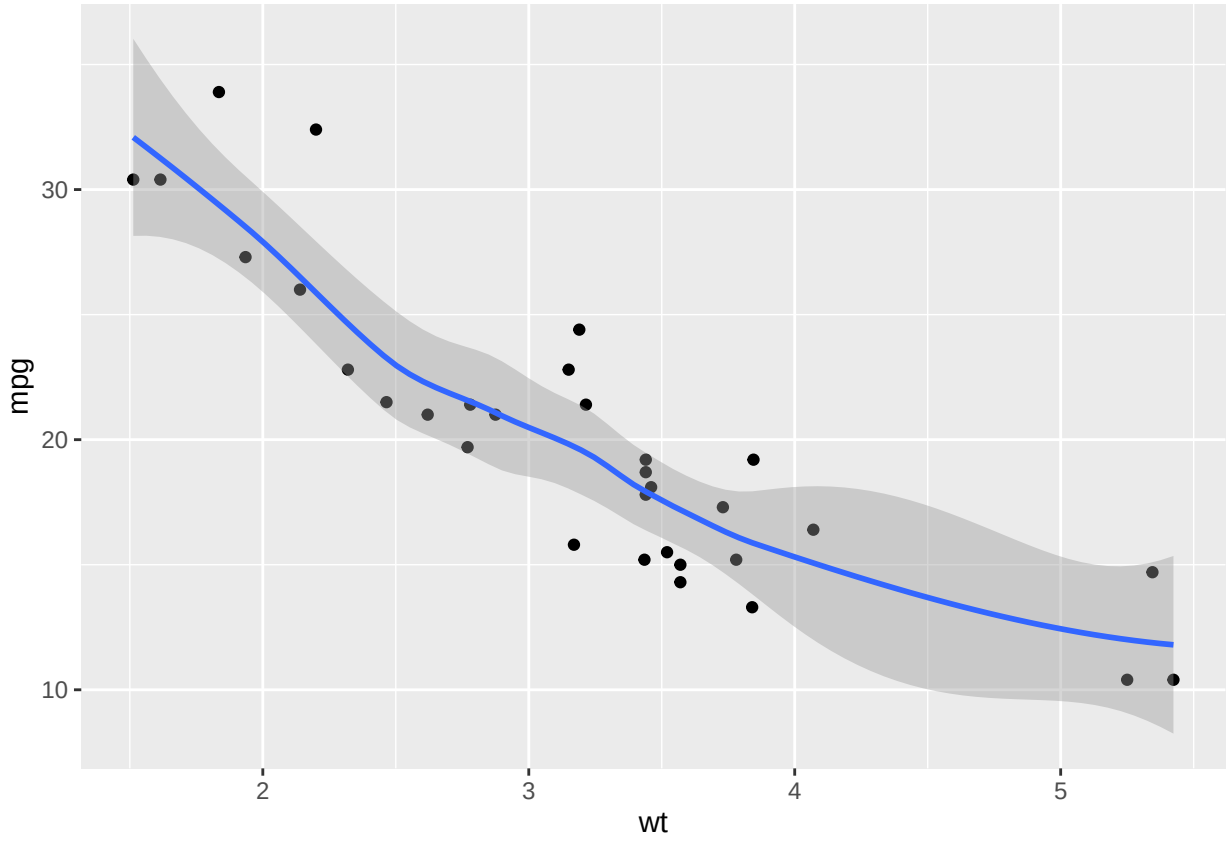
```
## `geom_smooth()` using formula 'y ~ x'
```



LOESS

```
ggplot(mtcars, aes(x = wt, y = mpg)) +
  geom_point()+
  geom_smooth(method="loess")
```

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



relationship(vs)

scatter plot over-plotting jittering demo

```
library(car)
head(Vocab)
```

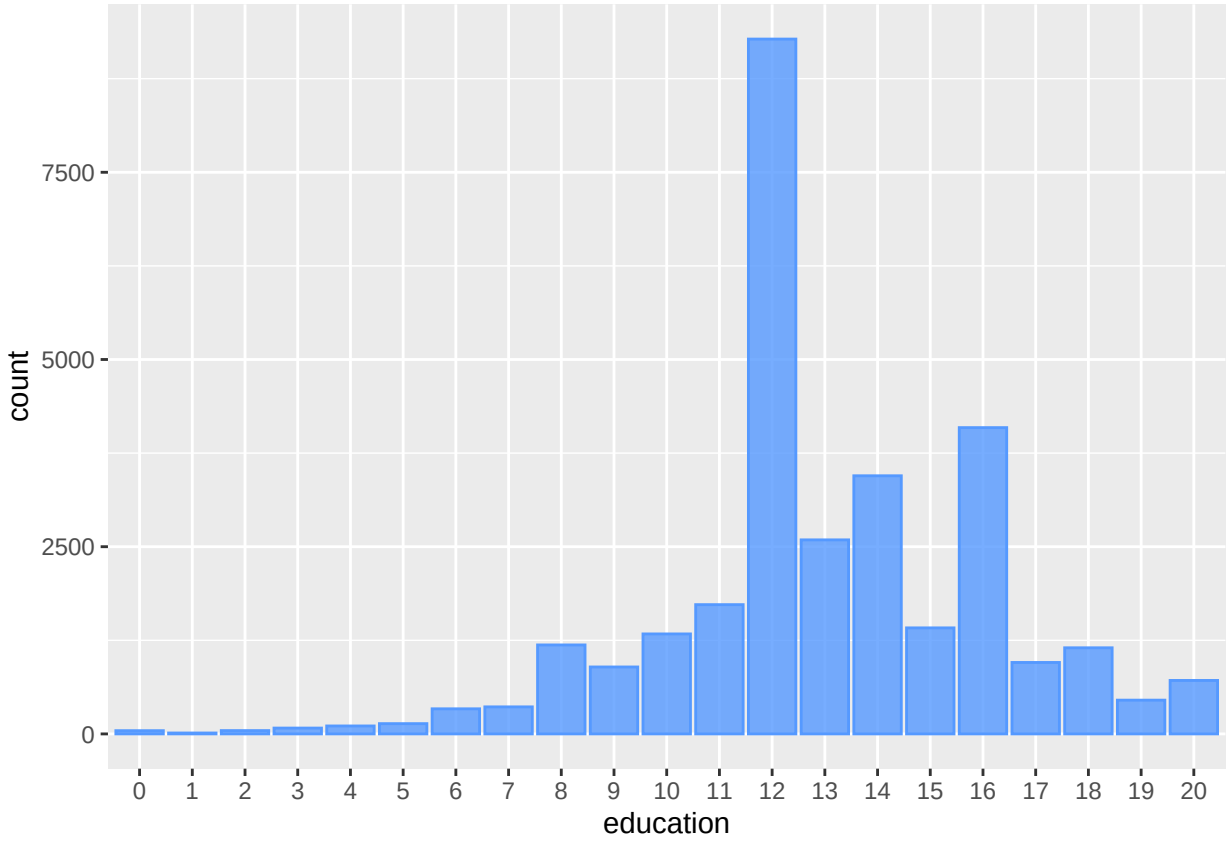
```
##          year    sex education vocabulary
## 19740001 1974   Male        14          9
## 19740002 1974   Male        16          9
## 19740003 1974 Female        10          9
## 19740004 1974 Female        10          5
## 19740005 1974 Female        12          8
## 19740006 1974   Male        16          8
```

```
Vocab$education <- factor(Vocab$education)
Vocab$vocabulary <- factor(Vocab$vocabulary)
summary(Vocab)
```

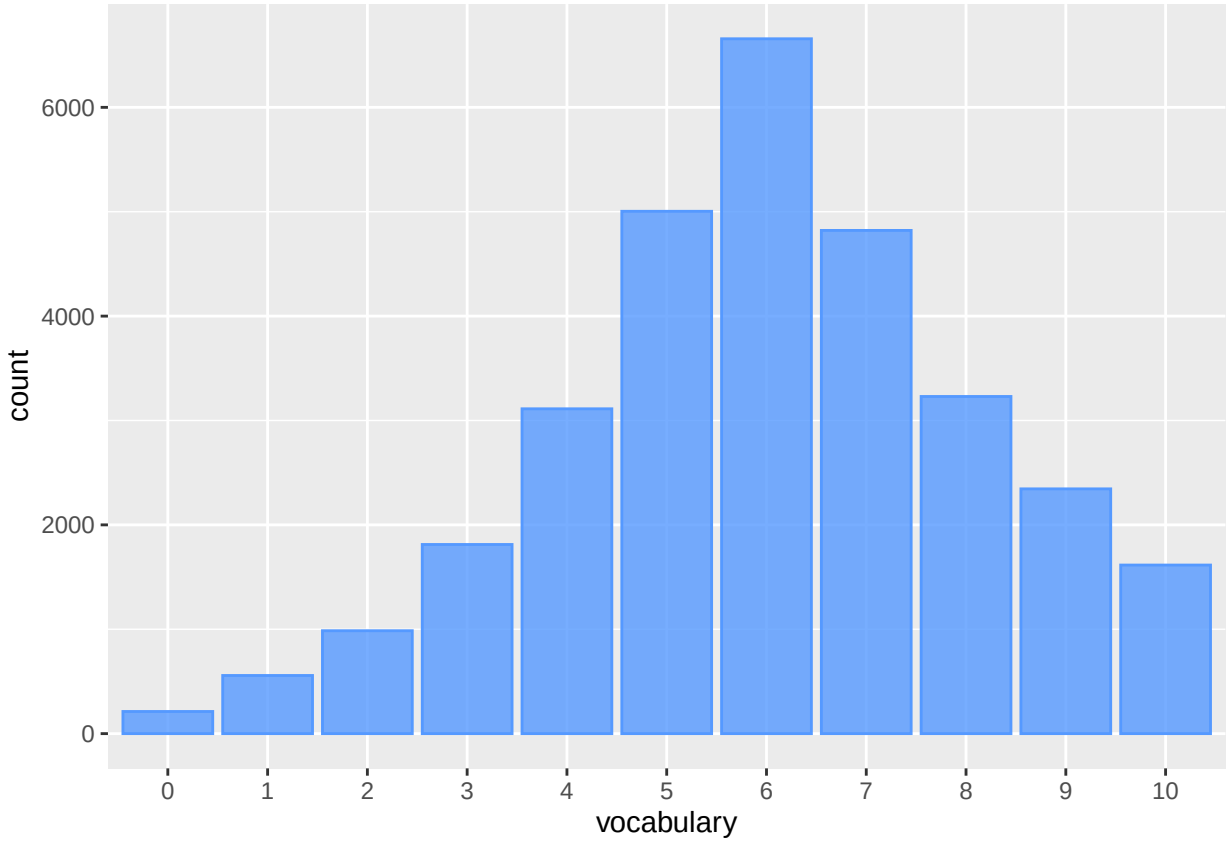
```
##       year          sex          education      vocabulary
##  Min.   :1974   Female:17148   12     :9279   6      :6657
##  1st Qu.:1987   Male  :13203   16     :4090   5      :5004
##  Median :1994                  14     :3447   7      :4821
##  Mean   :1995                  13     :2591   8      :3230
##  3rd Qu.:2006                  11     :1726   4      :3112
##  Max.   :2016                  15     :1416   9      :2345
```

```
##                                 (Other):7802   (Other):5182
```

```
ggplot(Vocab, aes(x=education))+
        geom_bar(col = "#5599FF", fill = "#5599FF", alpha = 0.8)
```

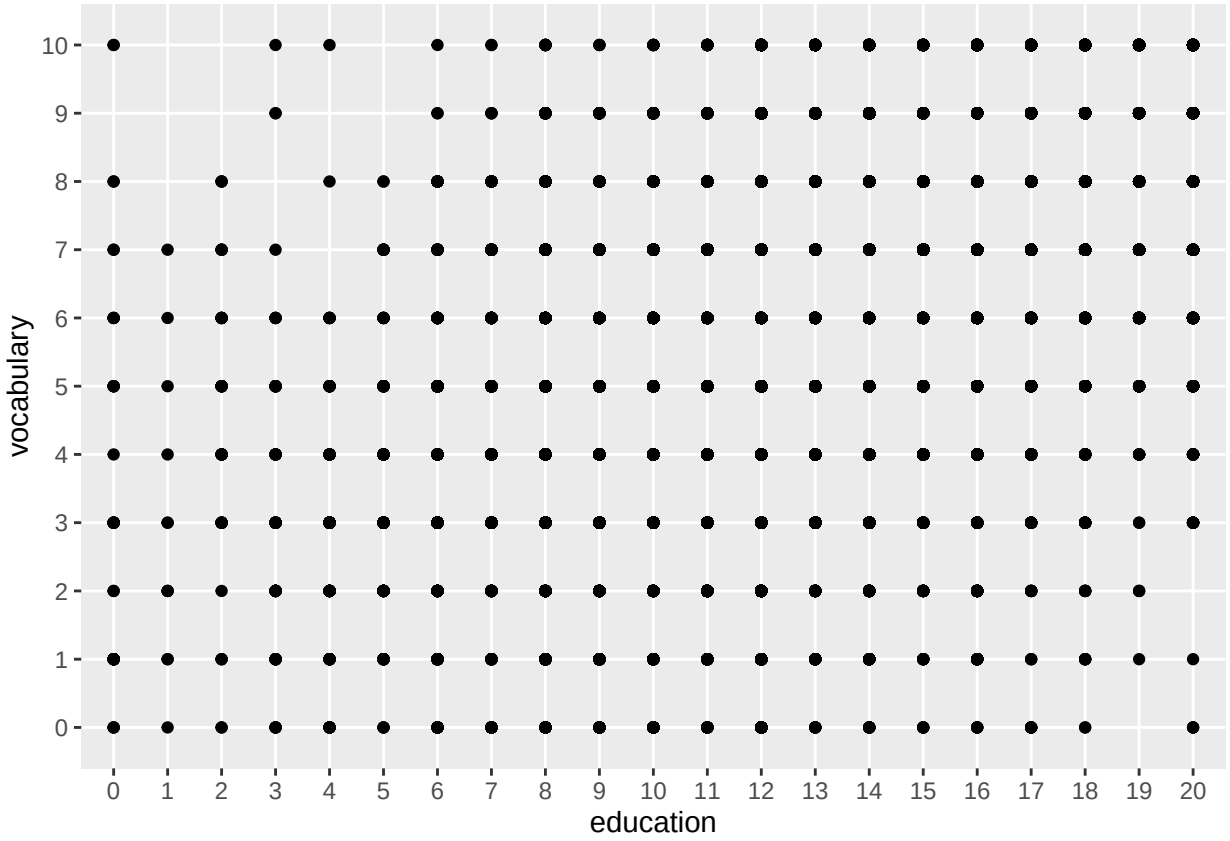



```
ggplot(Vocab, aes(x=vocabulary))+
        geom_bar(col = "#5599FF", fill = "#5599FF", alpha = 0.8)
```



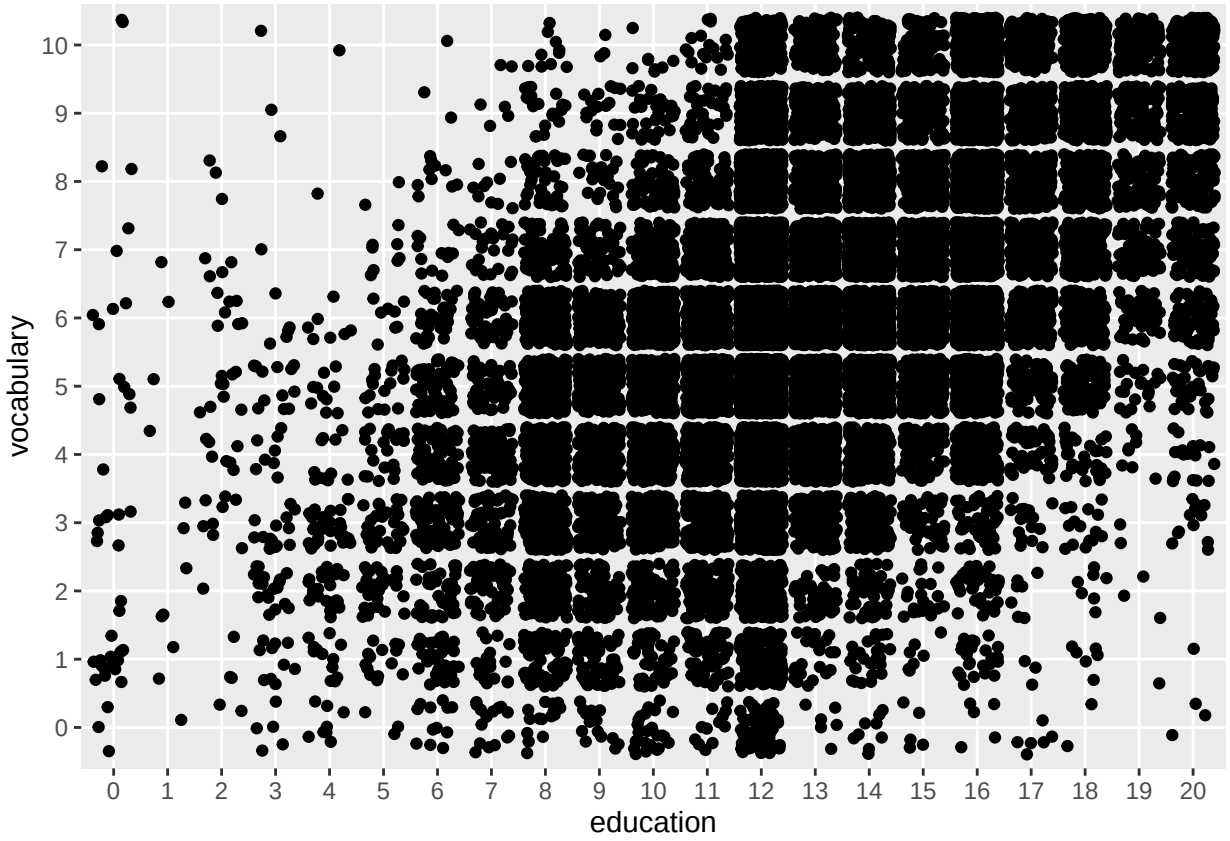
scatter plot

```
ggplot(data=Vocab, aes(x=education, y=vocabulary))+
  geom_point()
```



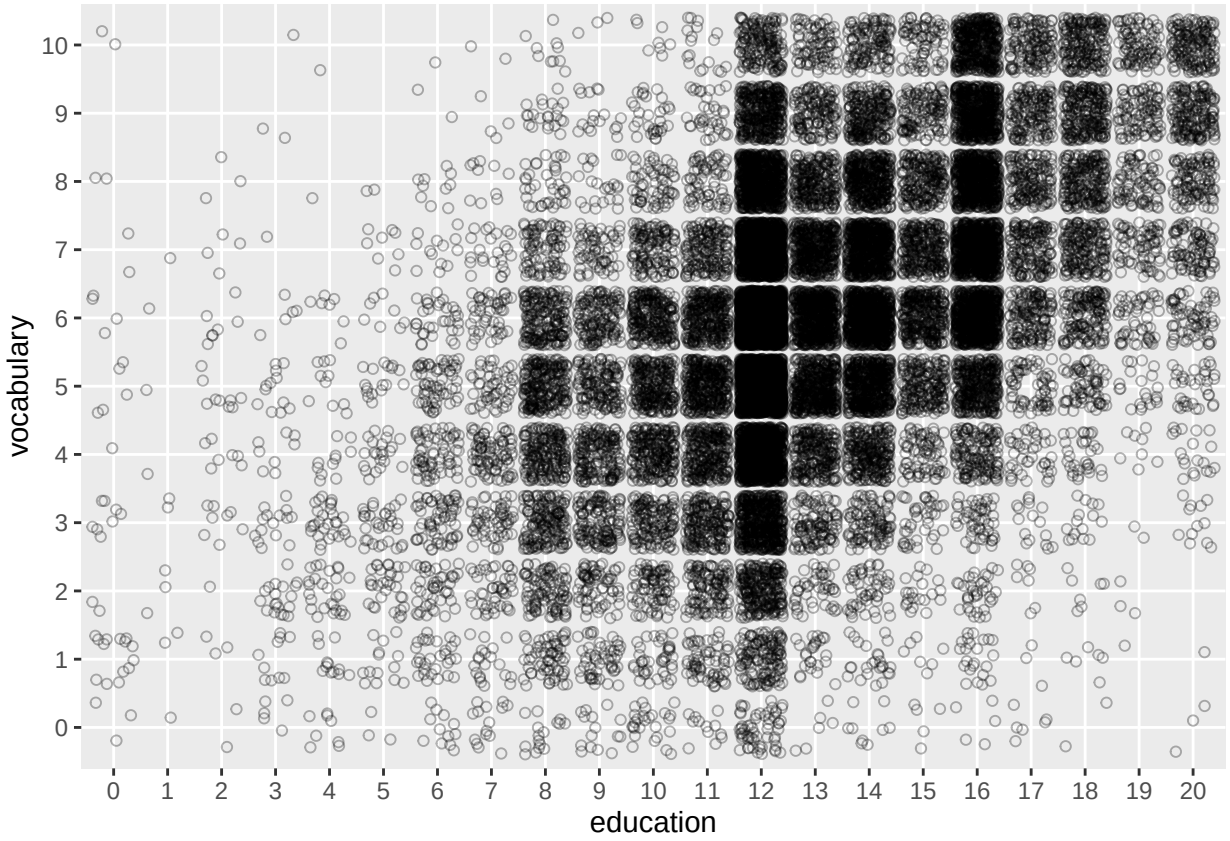
jitter

```
ggplot(data=Vocab, aes(x=education, y=vocabulary))+
  geom_jitter()
```



shape

```
ggplot(data=Vocab, aes(x=education, y=vocabulary))+
  geom_jitter(alpha = 0.3,shape=1)
```



wrap up

4.1 comparison(|)

```
#condition   (cyl) histogram
ggplot(mtcars, aes(x=mpg,fill=cyl)) + #  "fill"
        geom_histogram(bins = 10, position="identity", alpha=0.4)
#condition   (cyl) frequency plot
ggplot(mtcars, aes(x=mpg, col=cyl)) + #  "col"
        geom_freqpoly(bins=10) #  "freqpoly"
#condition    density plot
ggplot(mtcars, aes(x = mpg, col = cyl, fill = cyl)) + #  col fill?
        geom_density(bw=3, alpha = 0.3)
#condition    boxplot
ggplot(mtcars, aes(x = cyl, y = mpg)) +
  geom_boxplot()


# "facet_grid(row~col)"
ggplot(mtcars, aes(x=mpg)) +
        geom_histogram(bins = 10)+
        facet_grid(~cyl, labeller = label_both)
```

4.2 relationship(vs)

```
#conditional bar chart
ggplot(mtcars, aes(x=cyl, fill=vs))+
```

```
        geom_bar(position="fill") #  "fill"
#facet bar chart
ggplot(mtcars, aes(x=vs))+
        geom_bar()+
        facet_grid(.~cyl, labeller = label_both)
```

4.3 relationship(vs)

```
#scatter plot + lm
ggplot(mtcars, aes(x = wt, y = mpg)) +
  geom_point()+
  geom_smooth(method="lm")
```

4.4 relationship(vs)

```
# scatter plot overplotting
ggplot(data=Vocab, aes(x=education, y=vocabulary))+
  geom_point()

# jitter()
ggplot(data=Vocab, aes(x=education, y=vocabulary))+
  geom_jitter()
```

(scatter plot, conditional bar plot, dot plot, …)

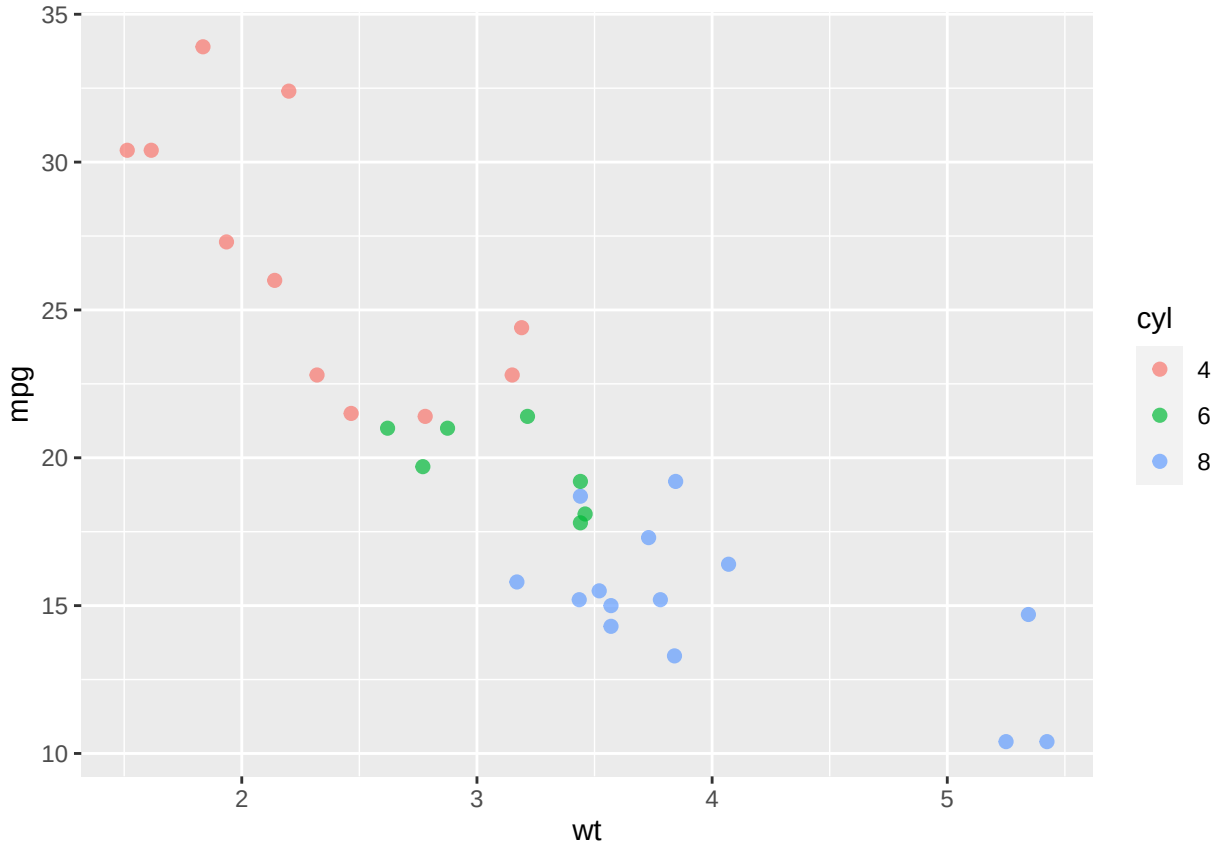
- color
- size
- shape
- facet

##scatter plot

wt (weight, wt) mpg ( ) cyl( )

1. color

```
ggplot(mtcars, aes(x=wt, y=mpg, col=cyl)) +
        geom_point(size=2, alpha=0.7)
```

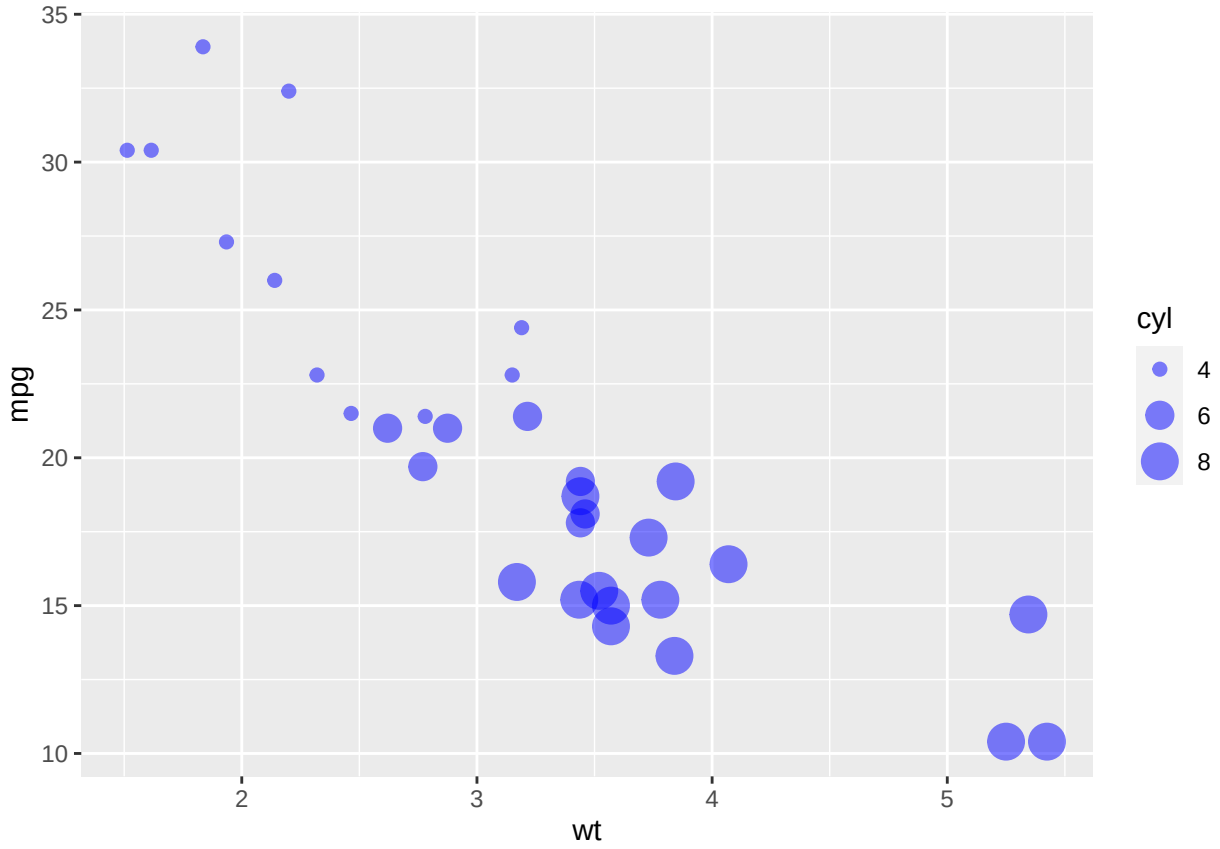


cyl=4
cyl=6
cyl=8

2. size

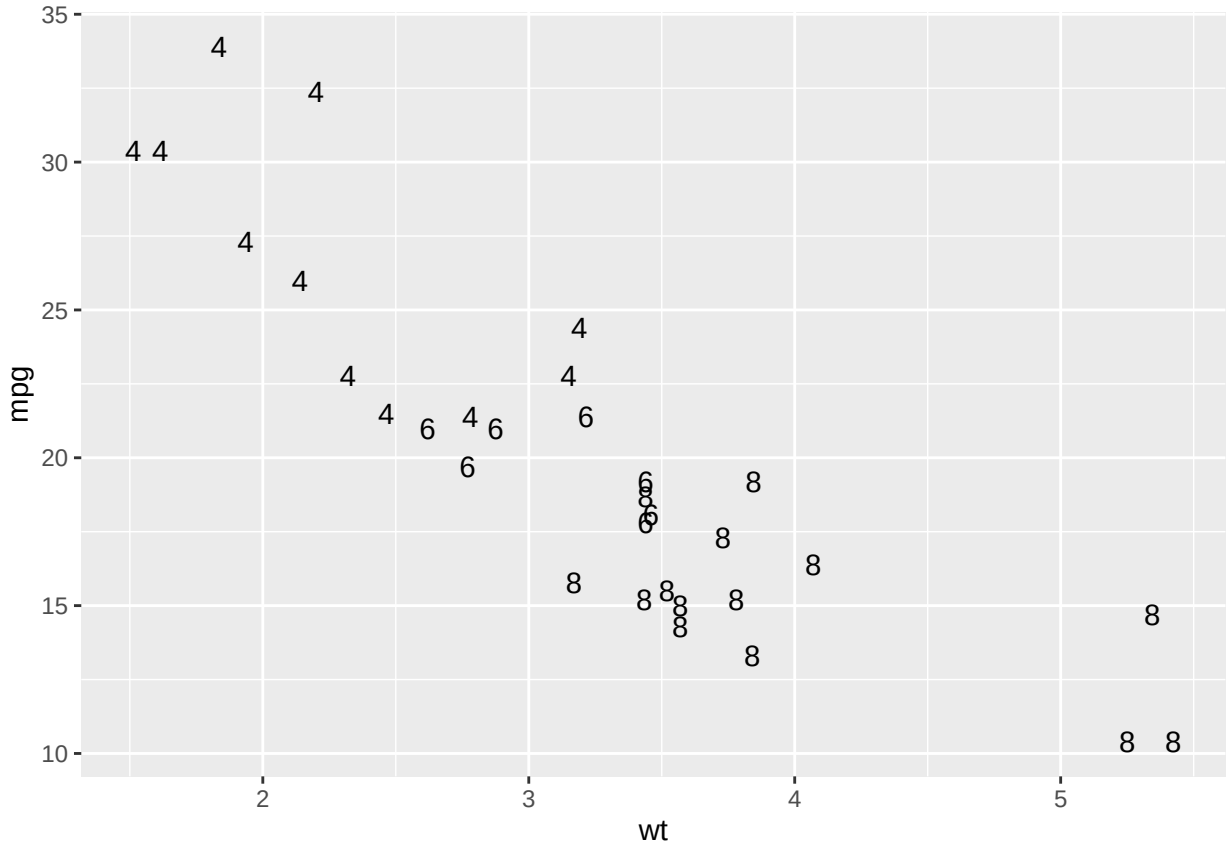
```
ggplot(mtcars, aes(x = wt, y = mpg, size = cyl)) +
  geom_point(alpha=0.5, col="blue")
```

```
## Warning: Using size for a discrete variable is not advised.
```



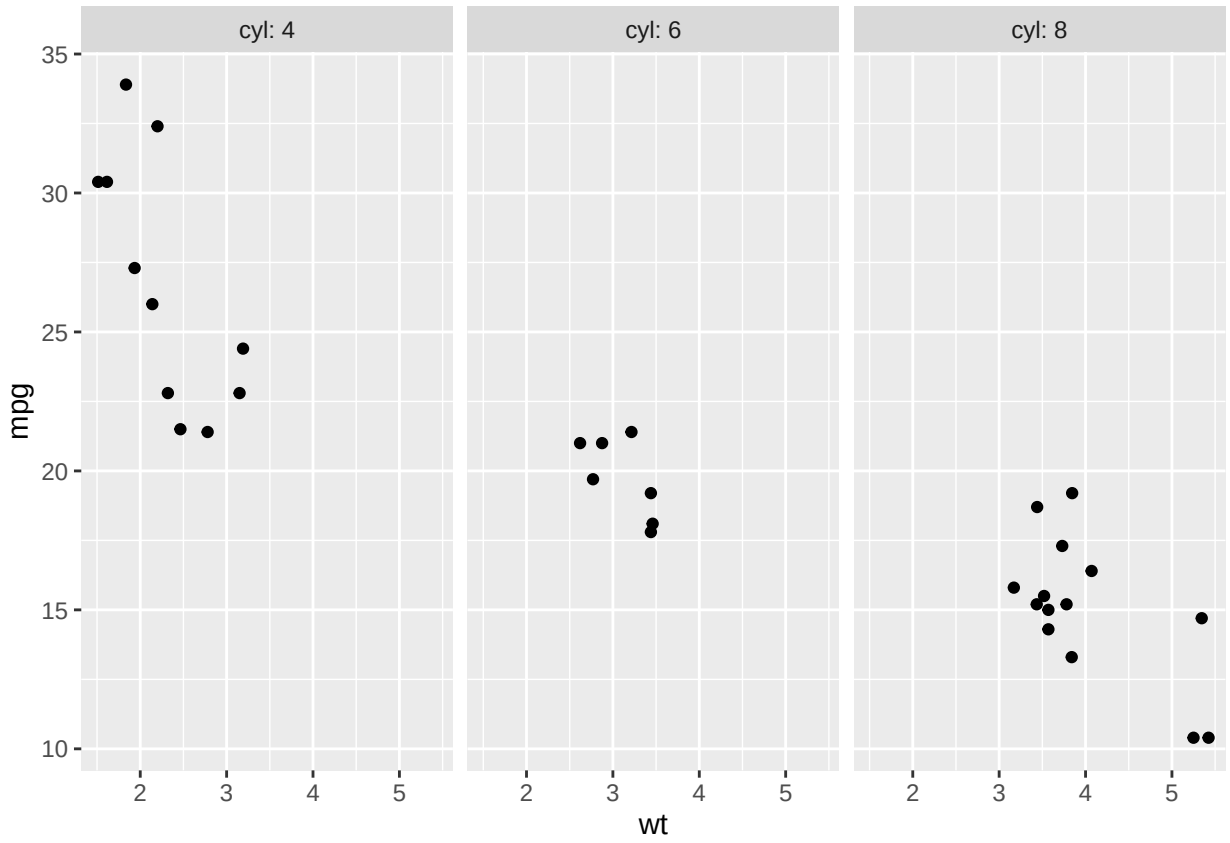
3. label

```
ggplot(mtcars, aes(x=wt, y=mpg, label=cyl))+
  geom_text()
```



4. facet

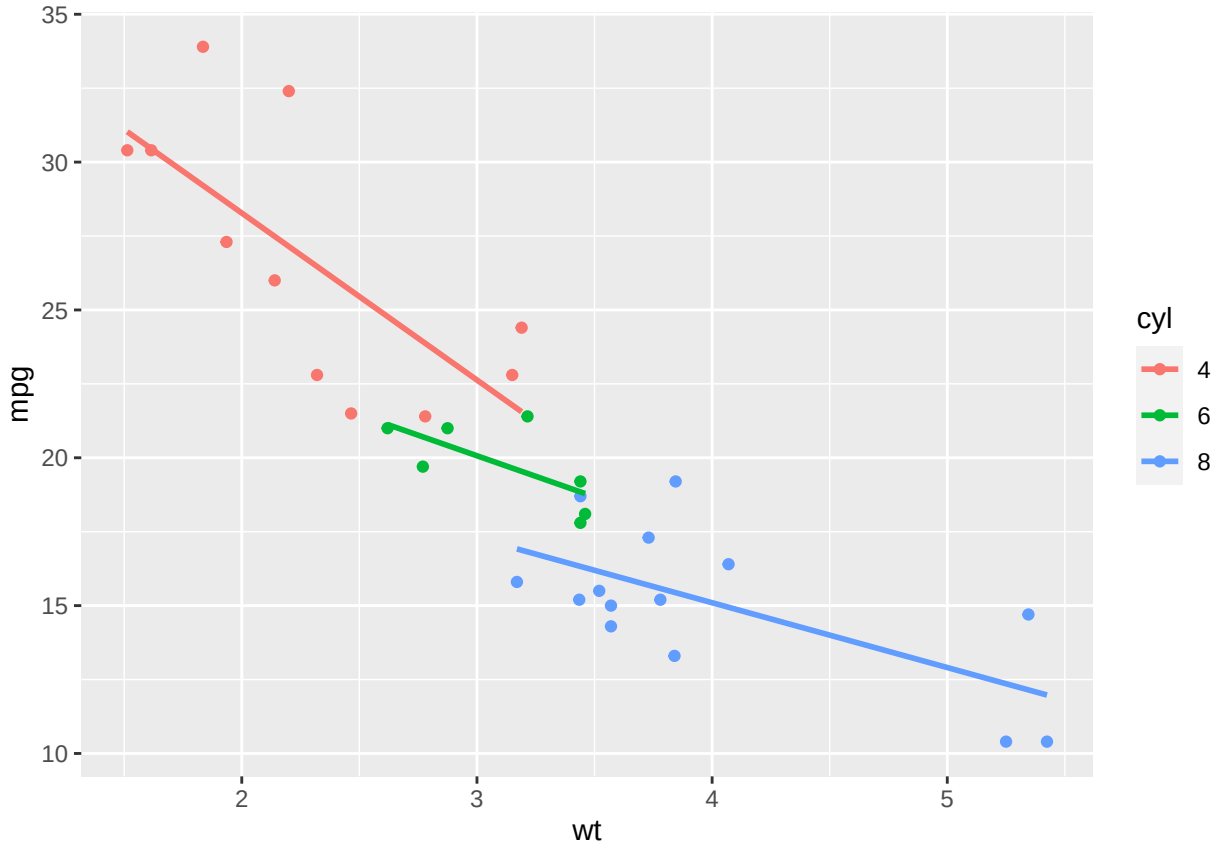
```
ggplot(mtcars, aes(x=wt, y=mpg)) +
        geom_point()+
        facet_grid(~cyl, labeller = label_both)
```



col fit linear model

```
ggplot(mtcars, aes(x = wt, y = mpg, col = cyl)) +
  geom_point() +
  stat_smooth(method = "lm", se = FALSE)
```

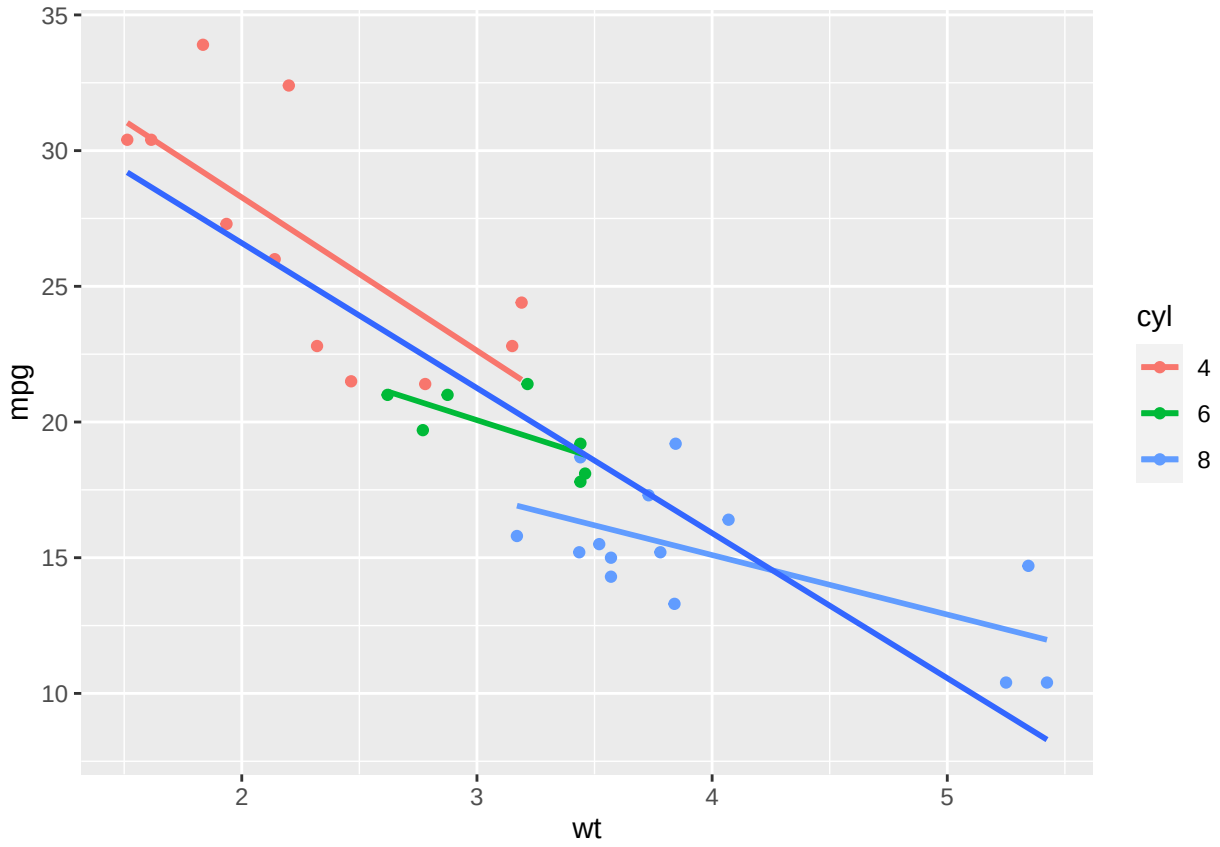
```
## `geom_smooth()` using formula 'y ~ x'
```



fit

```
ggplot(mtcars, aes(x = wt, y = mpg, col = cyl)) +
  geom_point() +
  stat_smooth(method = "lm", se = FALSE)+
  stat_smooth(aes(group=1),method = "lm", se = FALSE)
```

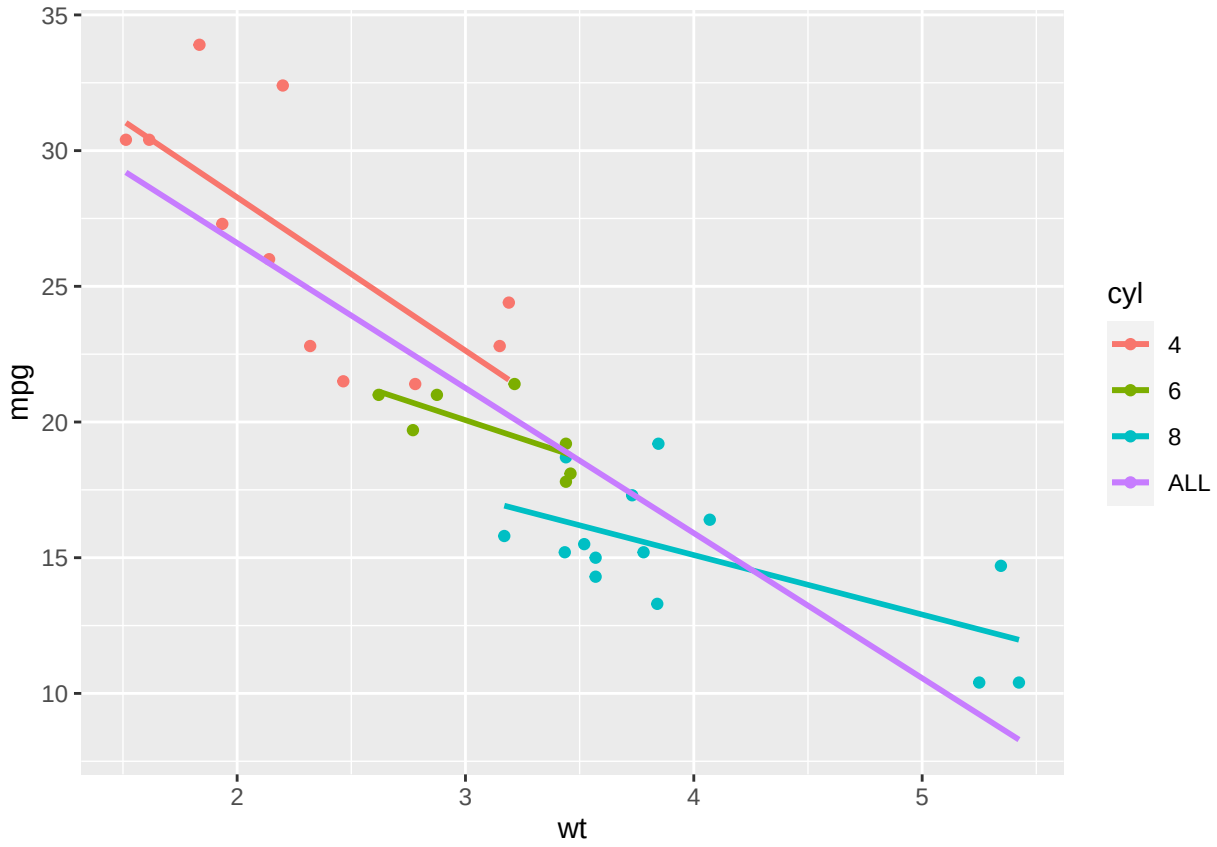
```
## `geom_smooth()` using formula 'y ~ x'
## `geom_smooth()` using formula 'y ~ x'
```



legend

```
ggplot(mtcars, aes(x = wt, y = mpg, col = cyl)) +
  geom_point() +
  stat_smooth(method = "lm", se = FALSE)+
  stat_smooth(aes(group=1, col="ALL"),method = "lm", se = FALSE)
```

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

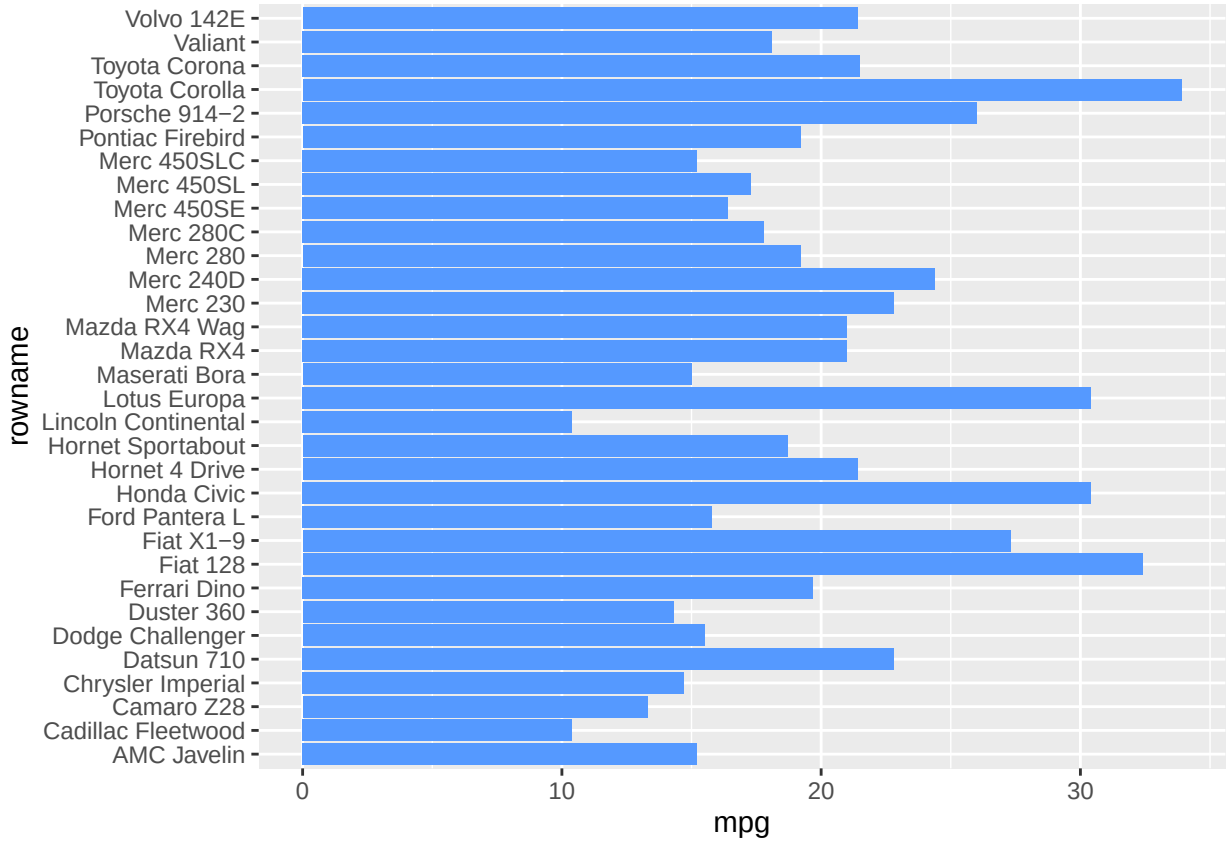


bar plot

(bar plot)

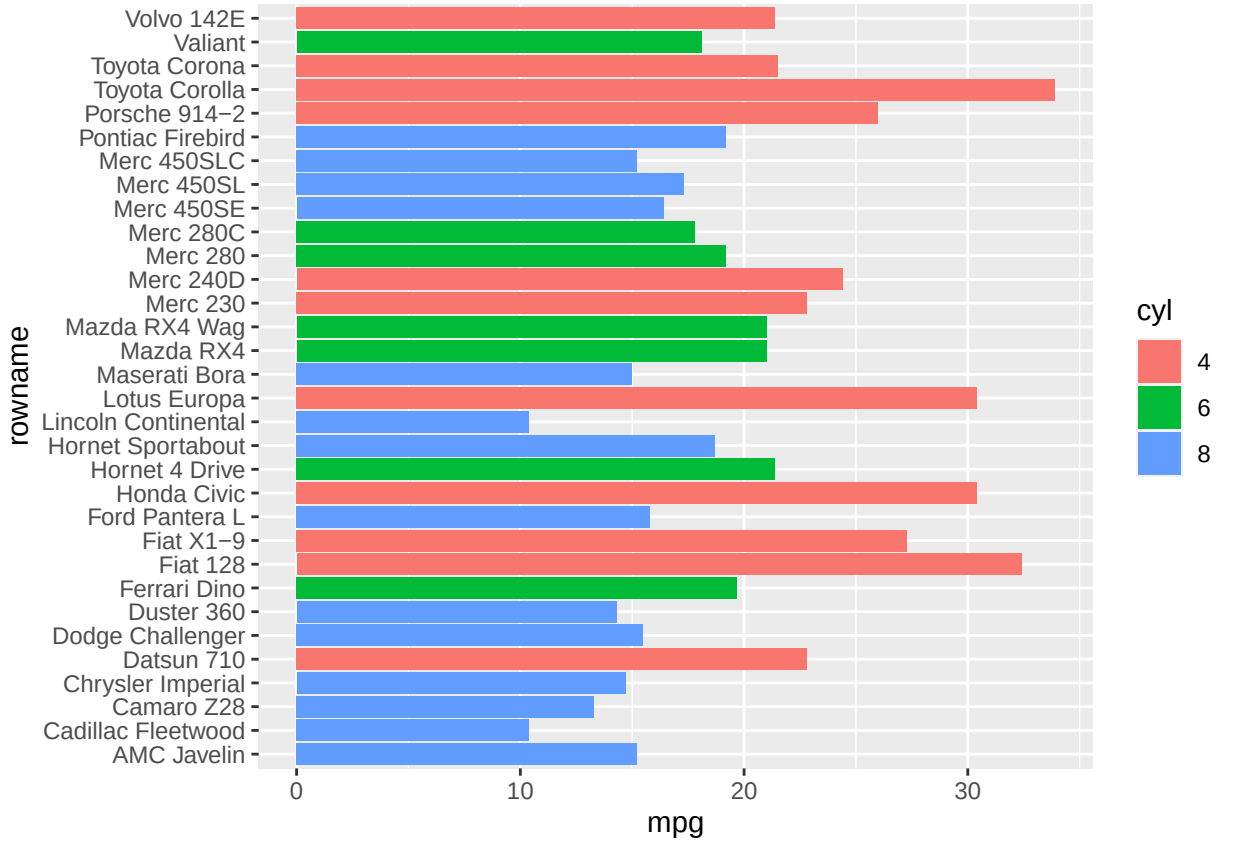
```
data(mtcars)
mtcars2 <- mtcars %>%
        rownames_to_column() %>%
        mutate(cyl=factor(cyl))

ggplot(mtcars2, aes(x=rowname, y=mpg))+
        geom_bar(stat="identity", fill = "#5599FF")+
        coord_flip()
```



color　　cyl

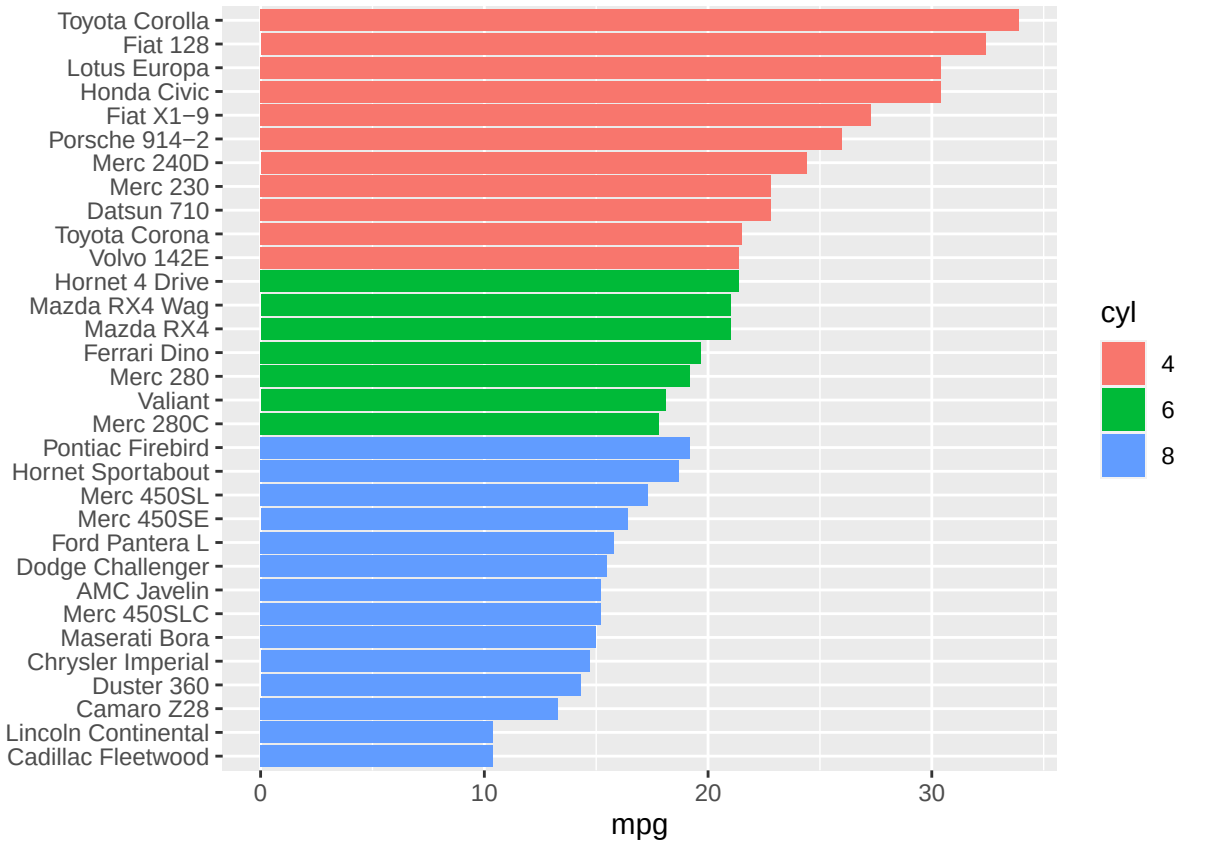
```
ggplot(mtcars2, aes(x=rowname, y=mpg, fill=cyl))+
        geom_bar(stat="identity")+
        coord_flip()
```



…

dplyr + forcats + ggplot !!

```
mtcars2 %>%
        arrange(desc(cyl), mpg) %>%
        ggplot(aes(x=fct_relevel(rowname, rowname), y=mpg, fill=cyl))+
        geom_bar(stat="identity")+
        labs(x="")+
        coord_flip()
```

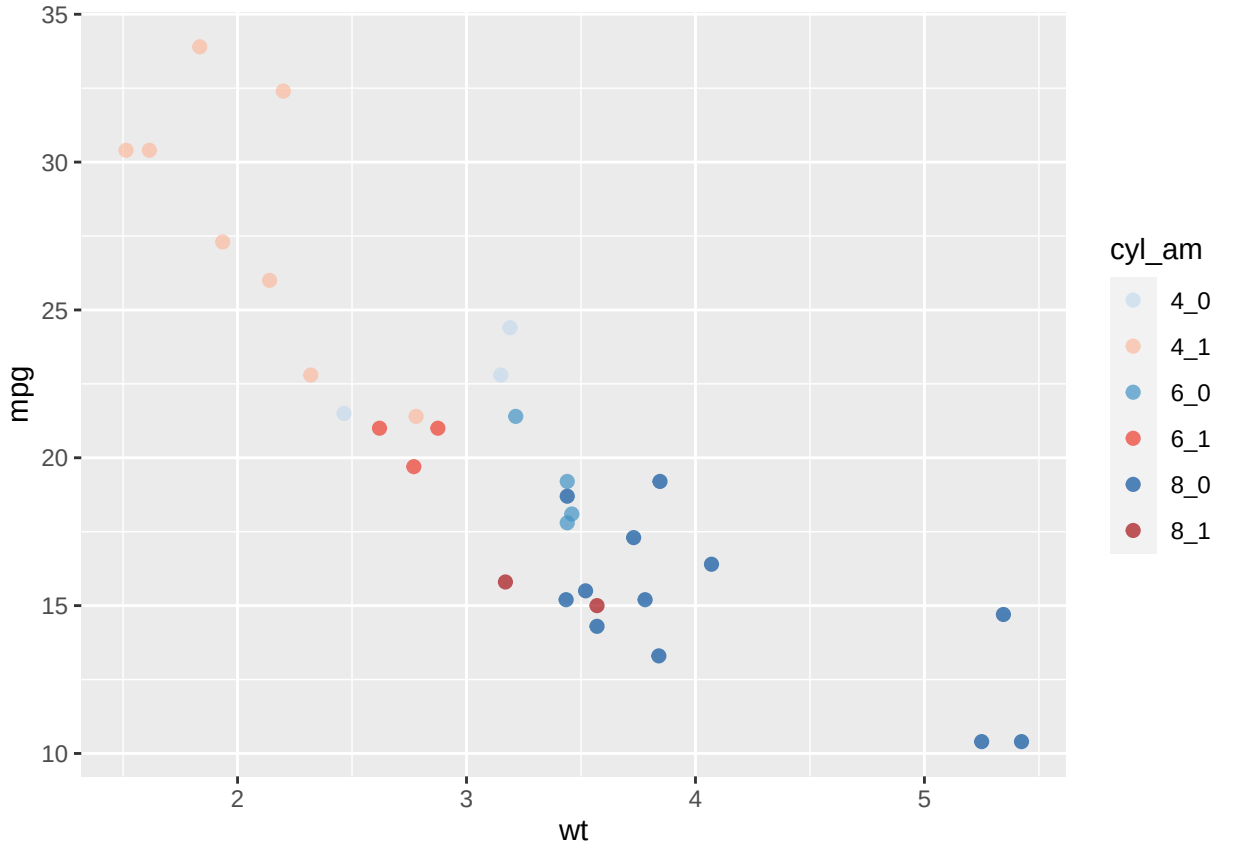


(wt) (mpg) scatter plot

1. level = 2

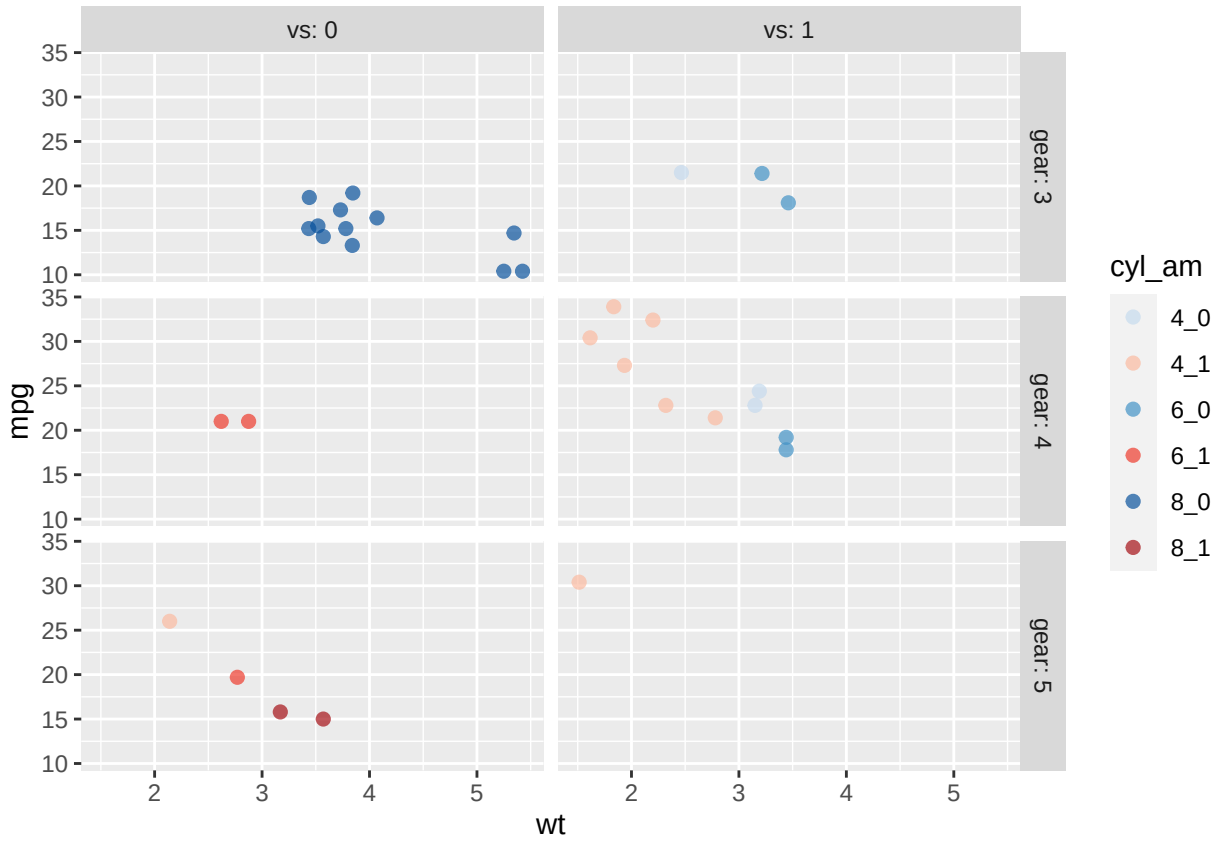
```
# cyl am
mtcars$cyl_am <- paste(mtcars$cyl, mtcars$am, sep = "_")
#
myCol <- rbind(brewer.pal(9, "Blues")[c(3,6,8)],
               brewer.pal(9, "Reds")[c(3,6,8)])

b1 <- ggplot(mtcars, aes(x = wt, y = mpg, col = cyl_am)) +
        geom_point(size=2, alpha=0.7) +
        # Add a manual colour scale
        scale_color_manual(values = myCol)
b1
```



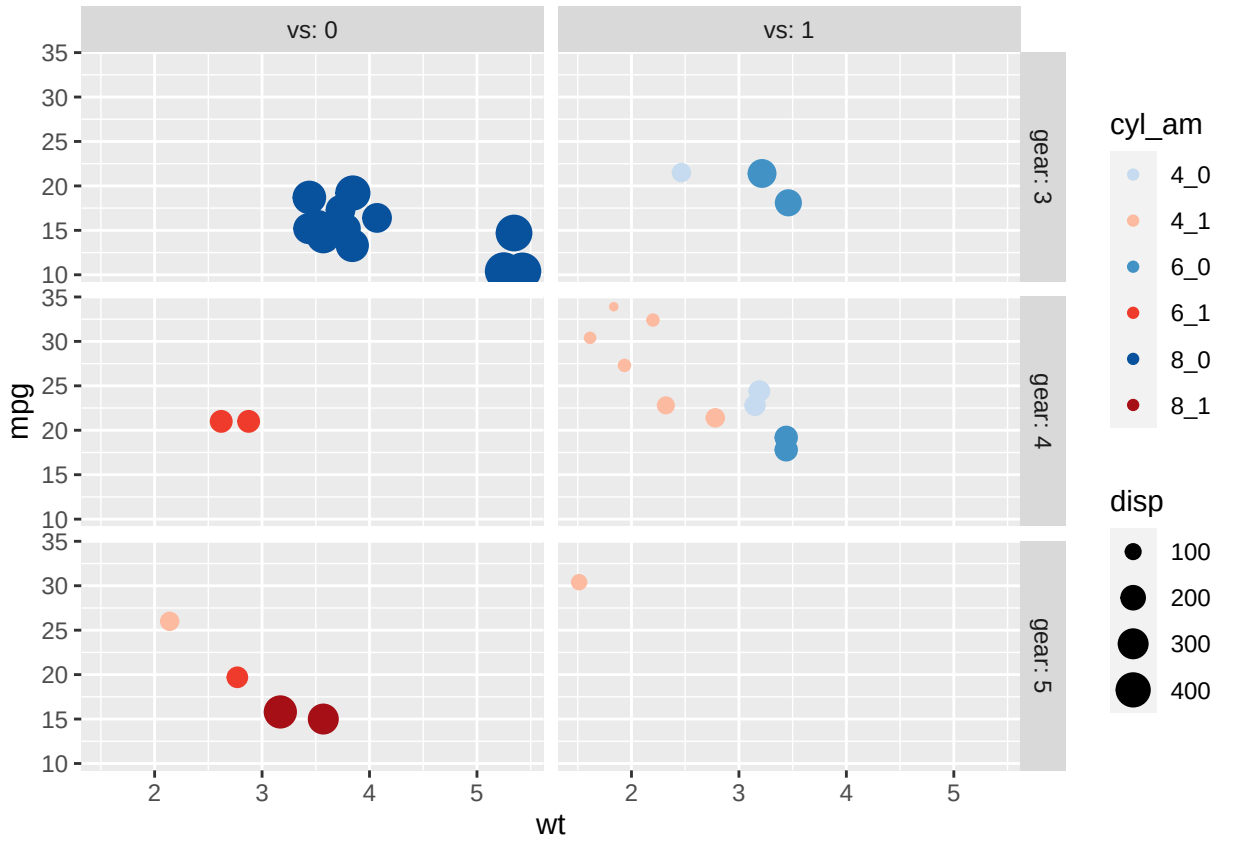
2. facet　gear & vs

```
b1 + facet_grid(gear~vs, labeller = label_both)
```



3. size disp

```
ggplot(mtcars, aes(x = wt, y = mpg, col = cyl_am, size=disp)) +
  geom_point() +
  scale_color_manual(values = myCol) +
  facet_grid(gear~vs, labeller = label_both)
```



... 7
(wt + mpg) scatter plot +
(cyl + am) +
disp +
(vs + gear)

XDD

Lattice

- (conditional graphs) `lattice`
- `ggplo2` `lattice base`
- `graph_type(formula, data=)`
- `formula`
- x, y F1, F2

graph_type	description	formula
xyplot	scatter plot	`y~x`
xyplot	scatter plot	`y~x|F1*F2`
histogram	histogram	`~x`
histogram	histogram	`~x|F1*F2`
densityplot	density plot	`~x|F1*F2`

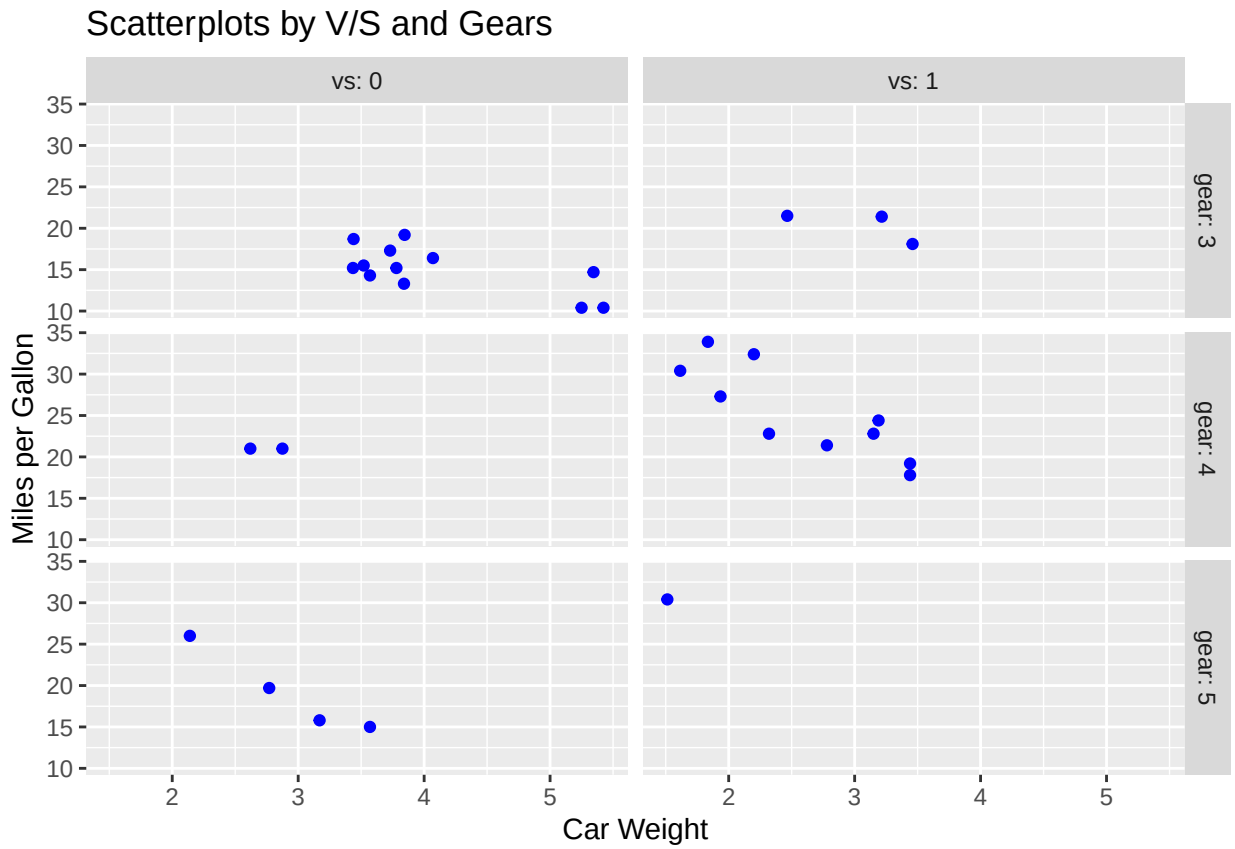
graph_type	description	formula
bwplot	boxplot	x~F1

##

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

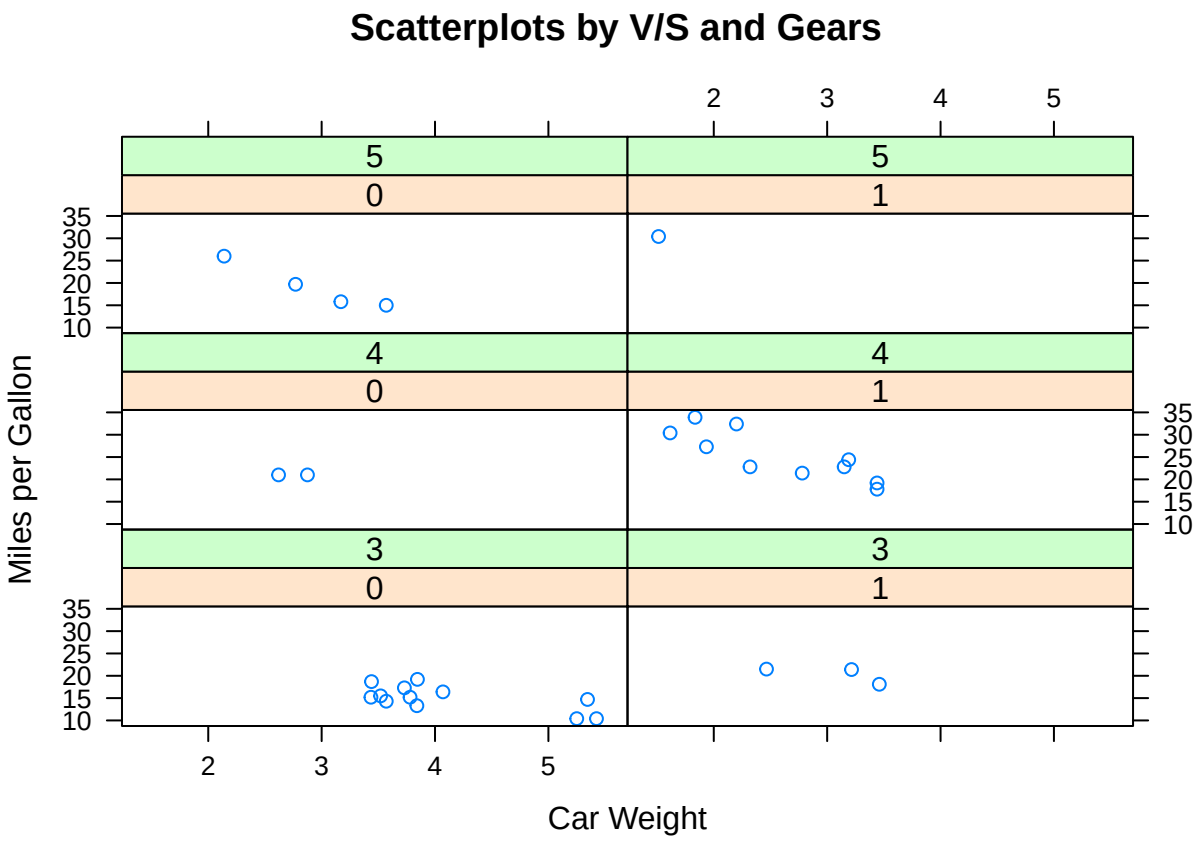
Scatter plot (ggplot2)

```
ggplot(mtcars, aes(x=wt, y=mpg))+
        geom_point(col="blue")+
        facet_grid(gear~vs, labeller = label_both)+
        labs(title="Scatterplots by V/S and Gears",
             x="Car Weight",
             y="Miles per Gallon")
```



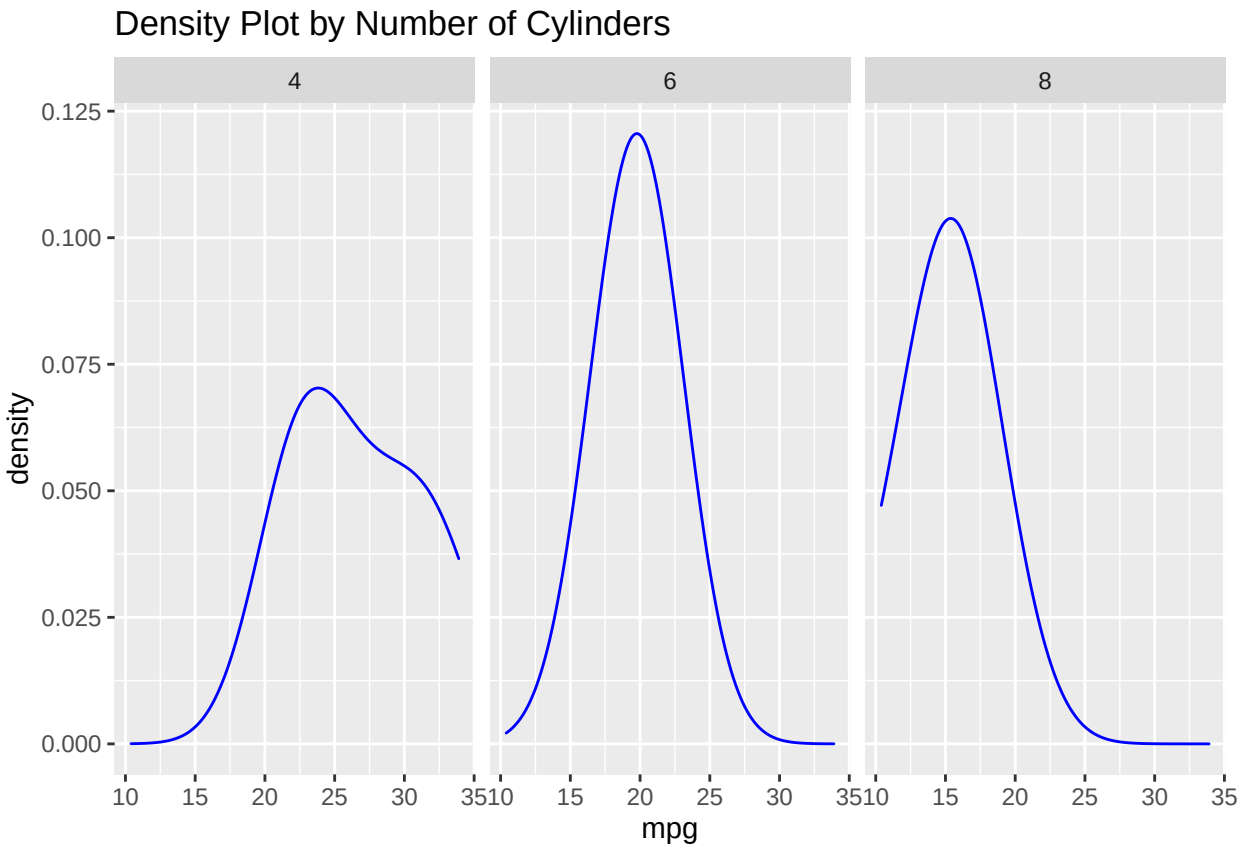
Scatter plot (lattice)

```
xyplot(mpg~wt|vs*gear, data=mtcars,
    main="Scatterplots by V/S and Gears",
       ylab="Miles per Gallon", xlab="Car Weight")
```



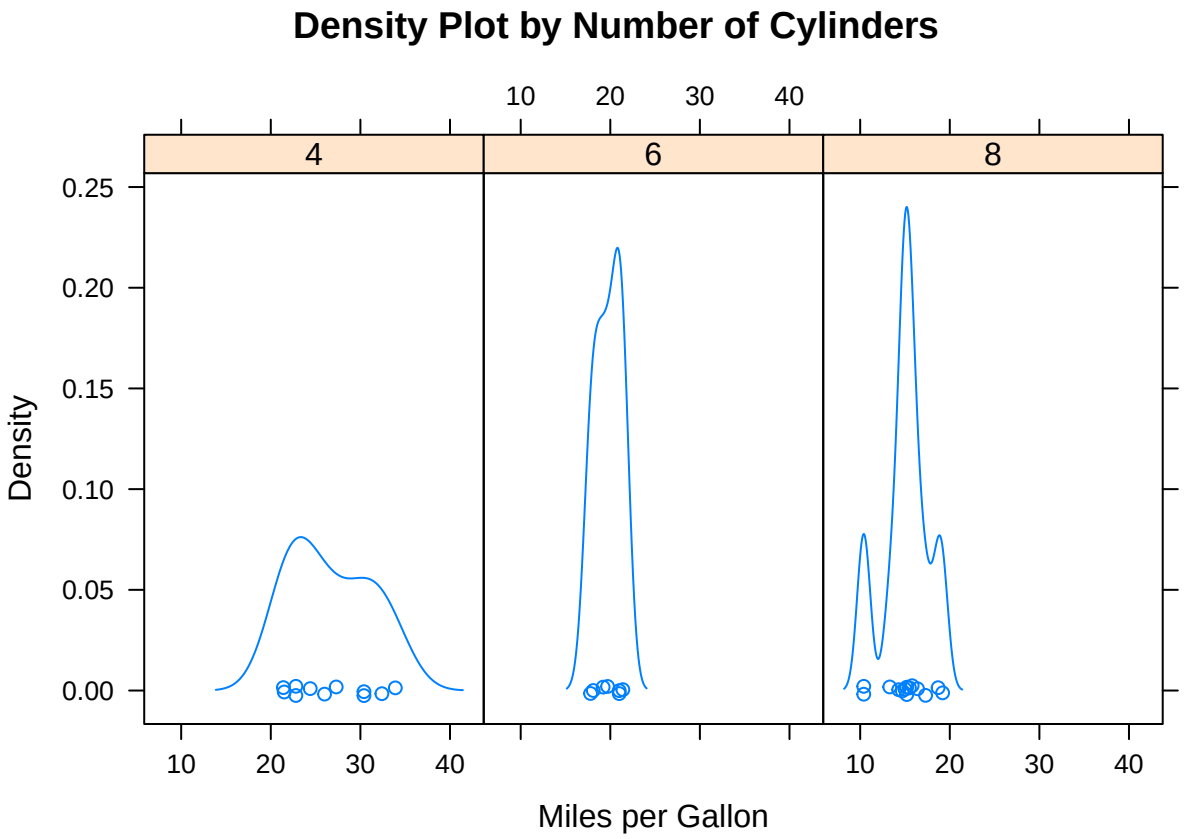
Density plot (ggplot2)

```
ggplot(mtcars, aes(x=mpg))+
        geom_density(bw=3, col="blue")+
        facet_grid(~cyl)+
        labs(title="Density Plot by Number of Cylinders",
             xlab="Miles per Gallon")
```



Density plot (lattice)

```
densityplot(~mpg|cyl, data=mtcars,
    main="Density Plot by Number of Cylinders",
    xlab="Miles per Gallon")
```



##
Lattice: Multivariate Data Visualization with R