Statistical Computing with R: MDS 503 (S13) Third Batch, SMS, TU, 2024

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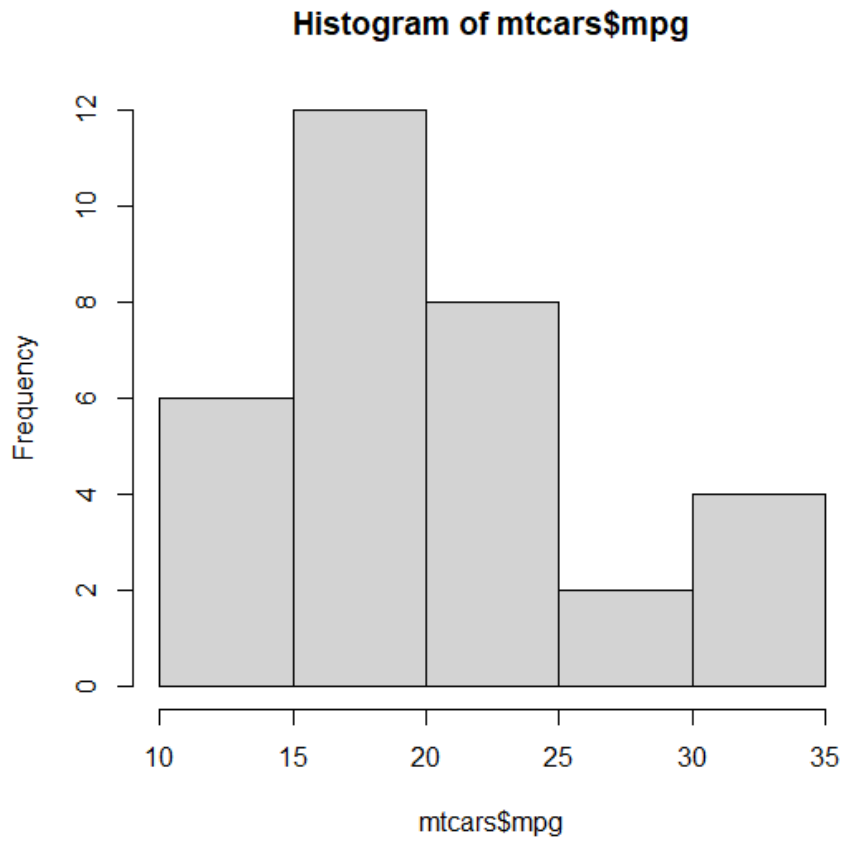
Review Preview

- Basic graphics/plots:
  - Plots from raw data
- Special graph:
  - Additional features

Graph from data frame

- Check the structure of in-built "mtcars" data
- Barplot of "mpg" variable
- Histogram of "mpg" variable
- Which one do you prefer?



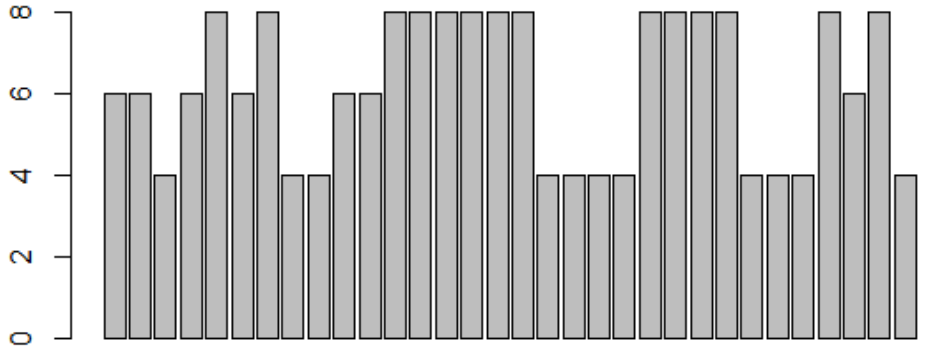
How to get bar diagram of a categorical variable from data frame?

#Define as data frame, if required

- df <- as.data.frame(mtcars)

#Bar plot of cylinder data

- barplot(df$cyl)



- **This barplot shows the number of cylinders for 50 cars of the dataset**

- **Do we want this?**

How to get bar diagram of a categorical variable from data frame?

#Let’s define cyl as factor variable

- f.cyl <- as.factor(df$cyl)

#And get gar plot of cylinder data

- barplot(f.cyl)

- Did you get the barplot?

- **Why?**

- Error in barplot.default(f.cyl) : 'height' must be a vector or a matrix

- **This means variable is factor but its frequencies are not found!**

- What to do now?

How to get bar diagram from data frame?

First we **need frequencies** of cars with 4, 6 and 8 cylinders

- table(df$cyl)

#Bar **plot of freq. of cylinder** data

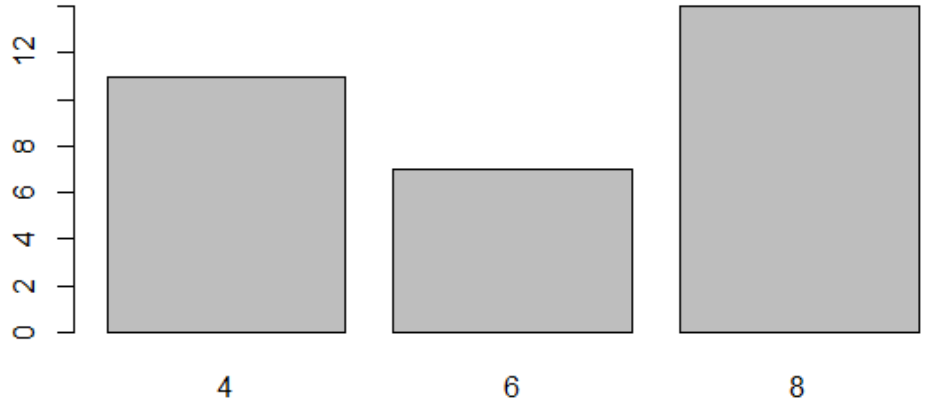
- barplot(table(df$cyl))

#We can assign this as object

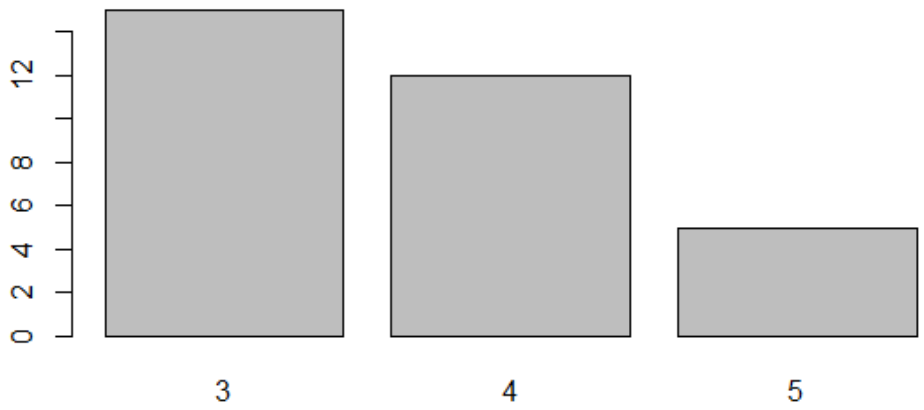
- bpd <- table(df$cyl)

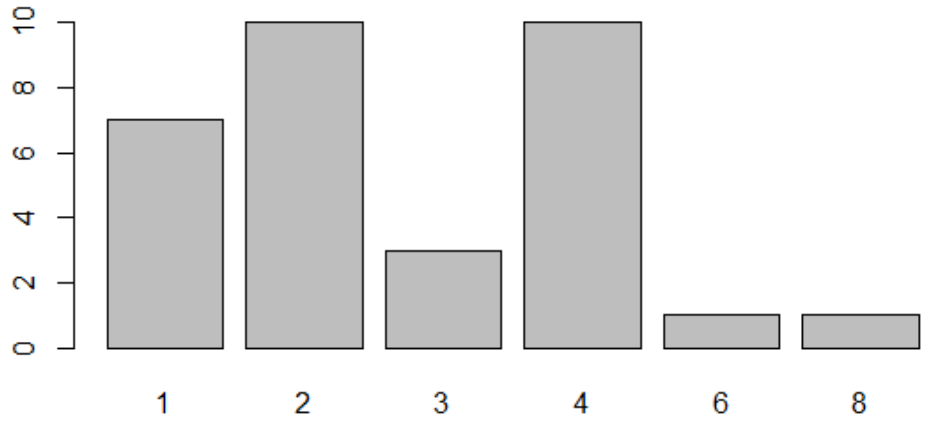
#Get the barplot

- barplot(bpd)



We can get the barplot of “gear” and “carb” too as they are factors (categorical variables)





Class work: How to get barplot of “mpg” variable? mpg: miles per gallon (continuous variable)

#MPG – range for class interval

- range(df$mpg)
- R = 33.9 - 10.4 #23.5
- I = round(sqrt(R)) # 5

#We need to construct 5 classes with width of 5 (10, 15, 20, 25, 30)

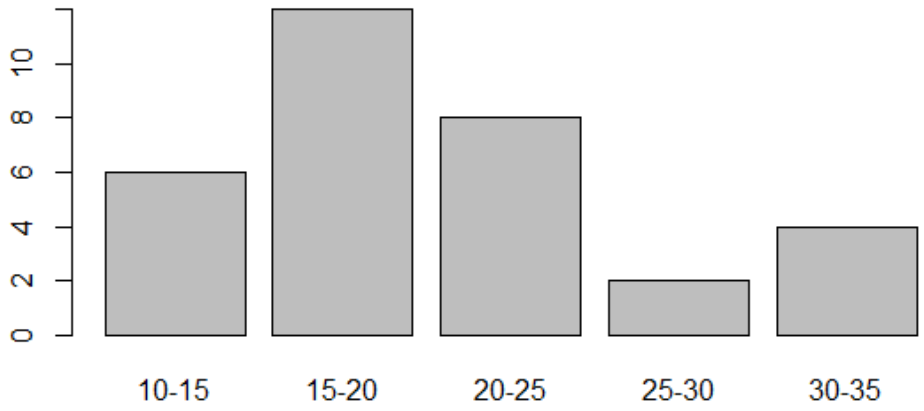
#We need to define the breaks

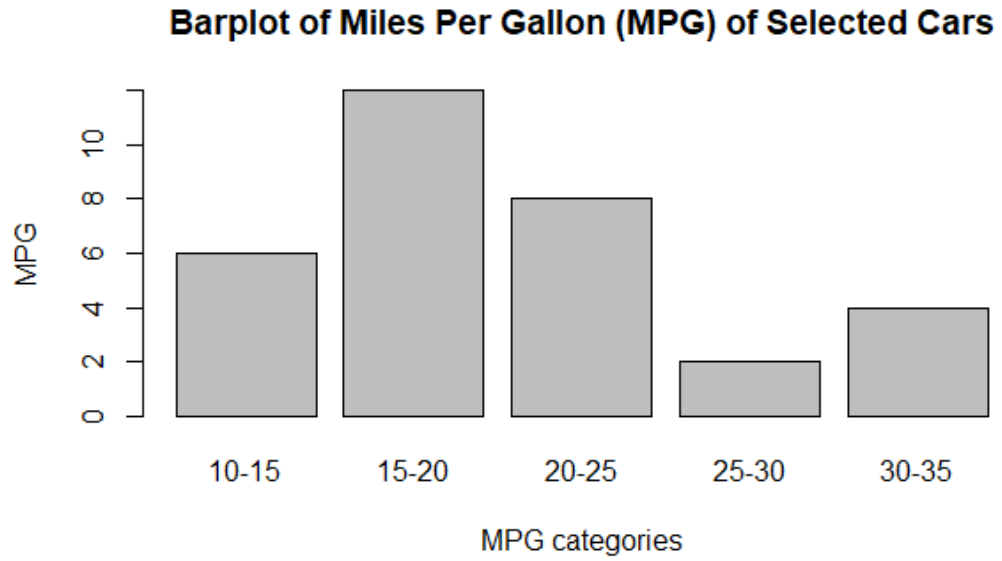
breaks = c(10, 15, 20, 25, 30, 35) or

breaks = seq(10, 35, by=5)

- mpg.bin <- cut(df$mpg, breaks, labels = c("10-15", "15-20", "20-25", "25-30", "30-35"))
- mpg.bin
- table(mpg.bin)
- barplot(table(mpg.bin))

Outputs:



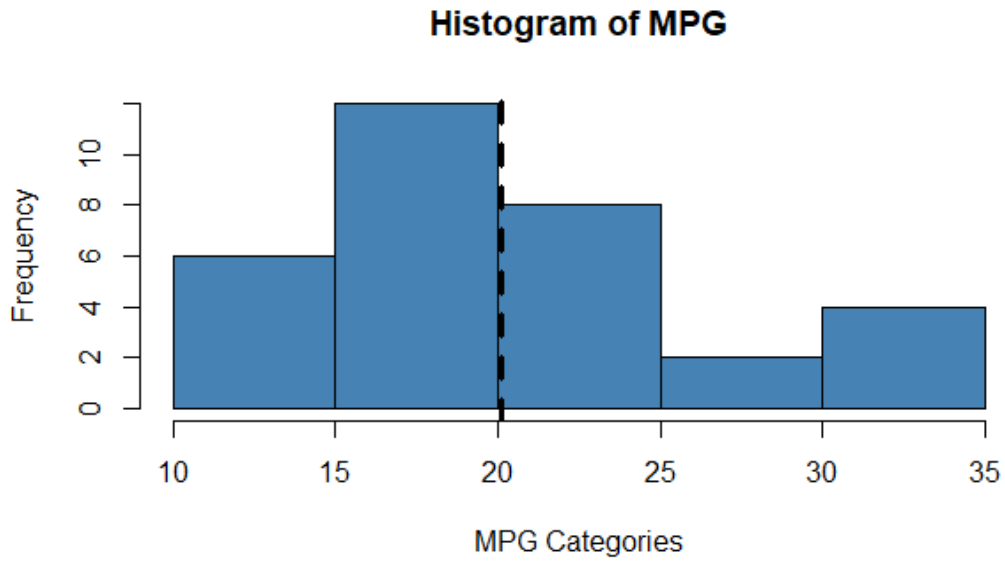


WHAT ARE THE TWO KEY DIFFERENCES BETWEEN BAR DIAGRAM AND HISTOGRAM?

Histogram and abline for mean of “mpg”:

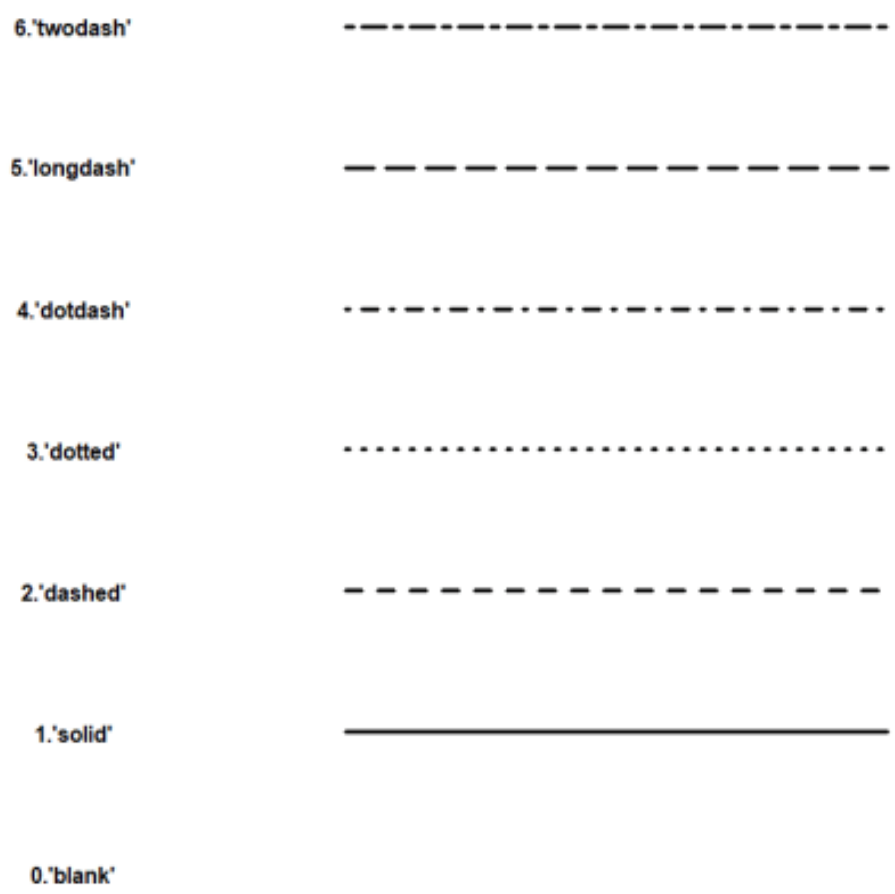
- hist(df$mpg, col = "steelblue", main = "Histogram of MPG", xlab = "MPG Categories")
- abline(**v**=mean(df$mpg), lwd=3, lty=2)

- v = vertical “abline”
- h = horizontal “abline”
- lwd = line width (3=3 times wide)
- lty =line types (2 = dashed line)



Line types:

- lty = 1 (solid line)
- lty = 2 (dashed line)
- lty = 3 (dotted line)
- lty = 4 (dot and dashed line)
- lty = 5 (long dash line)
- lty = 6 (two dashed line)

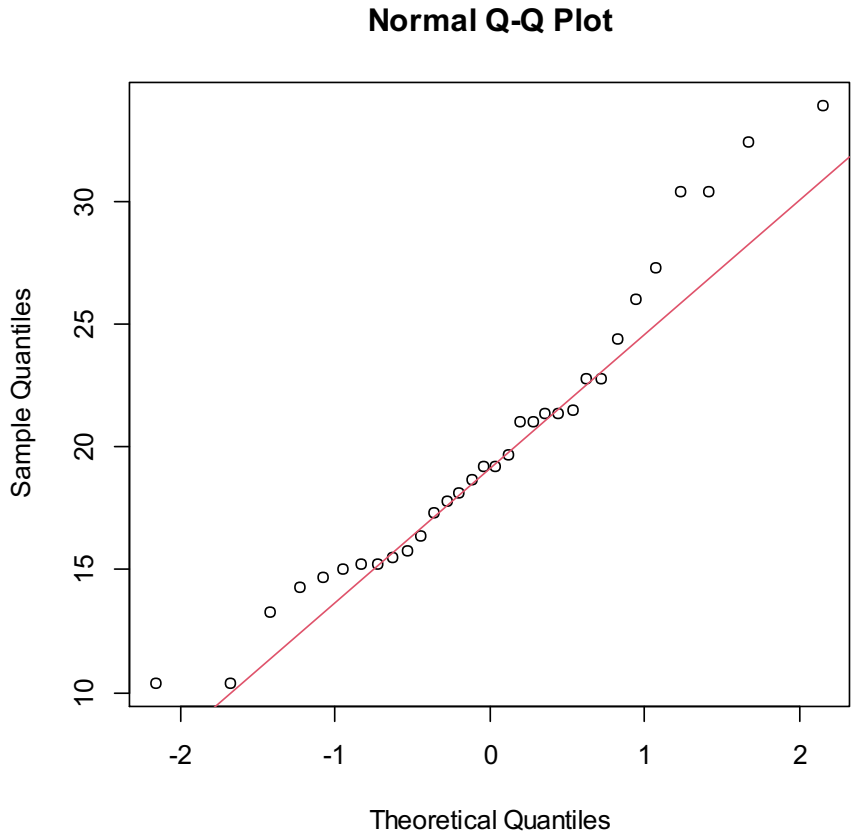


Can you justify the use of mean for “mpg” variable in the histogram?

- qqnorm(mtcars$mpg)
- > qqline(mtcars$mpg, col=2)

- Which measure of central tendency is most useful for the mpg variable?

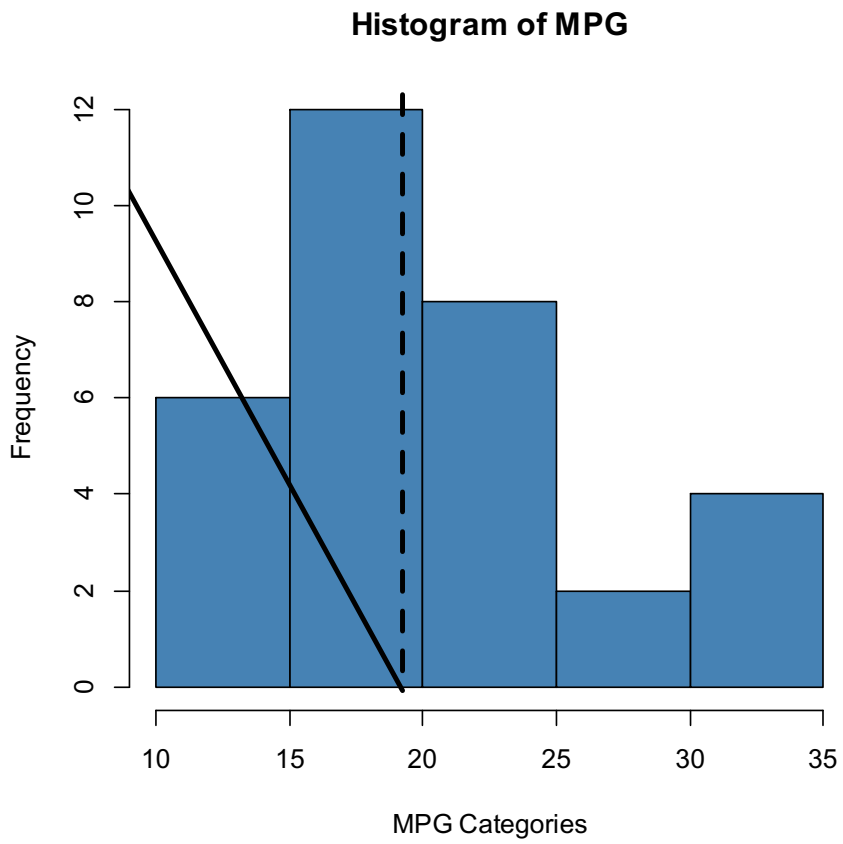
- Which measure of central tendency can be located by histogram “graphically”?



Histogram and abline of median of “mpg”:

- hist(df$mpg, col = "steelblue", main = "Histogram of MPG", xlab = "MPG Categories")
- abline(**v**=median(df$mpg), lwd=3, lty=2)

- v = vertical “abline”
- h = horizontal “abline”



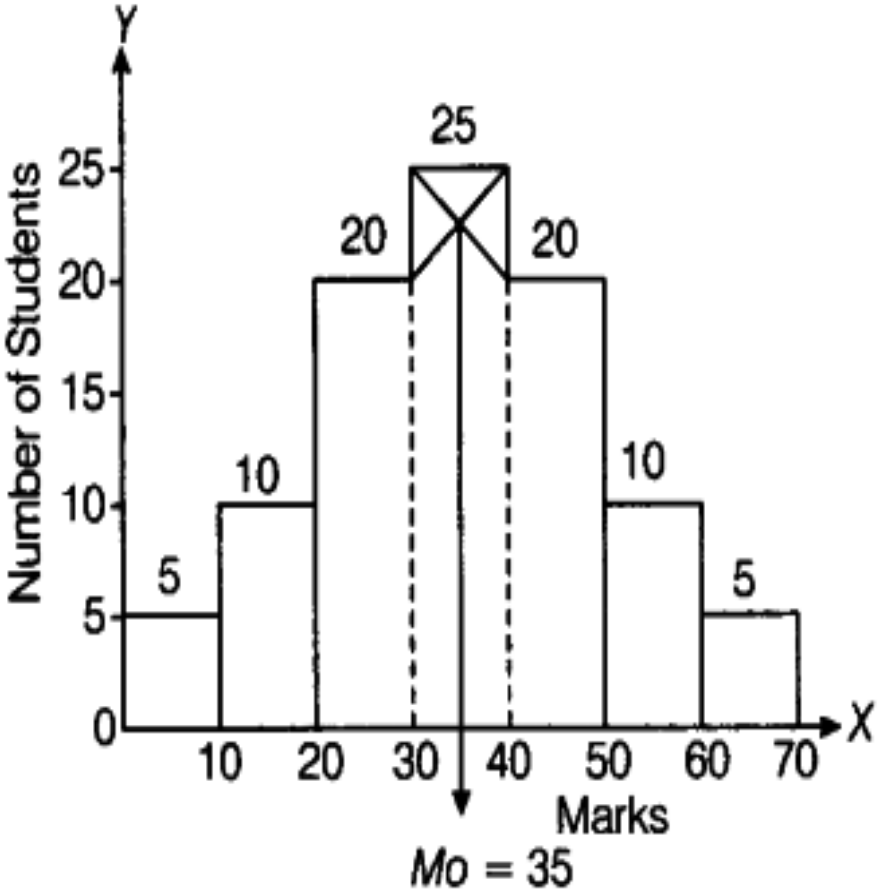
summary(df$mpg)

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10.40	15.43	19.20	20.09	22.80	33.90

Assignment: Locate median **graphically** for "mpg" variable

- Create a more than cumulative frequency curve
- Create a less than cumulative frequency curve
- Draw both of them in a single plot
- The point of intersection of more than and less than cumulative frequency curve will given the "median" value
- Draw a perpendicular to the x-axis from this point of intersection to find the median
- Compare it with the result of the "median" function of R!

Class work: Locate the mode in the histogram graphically!

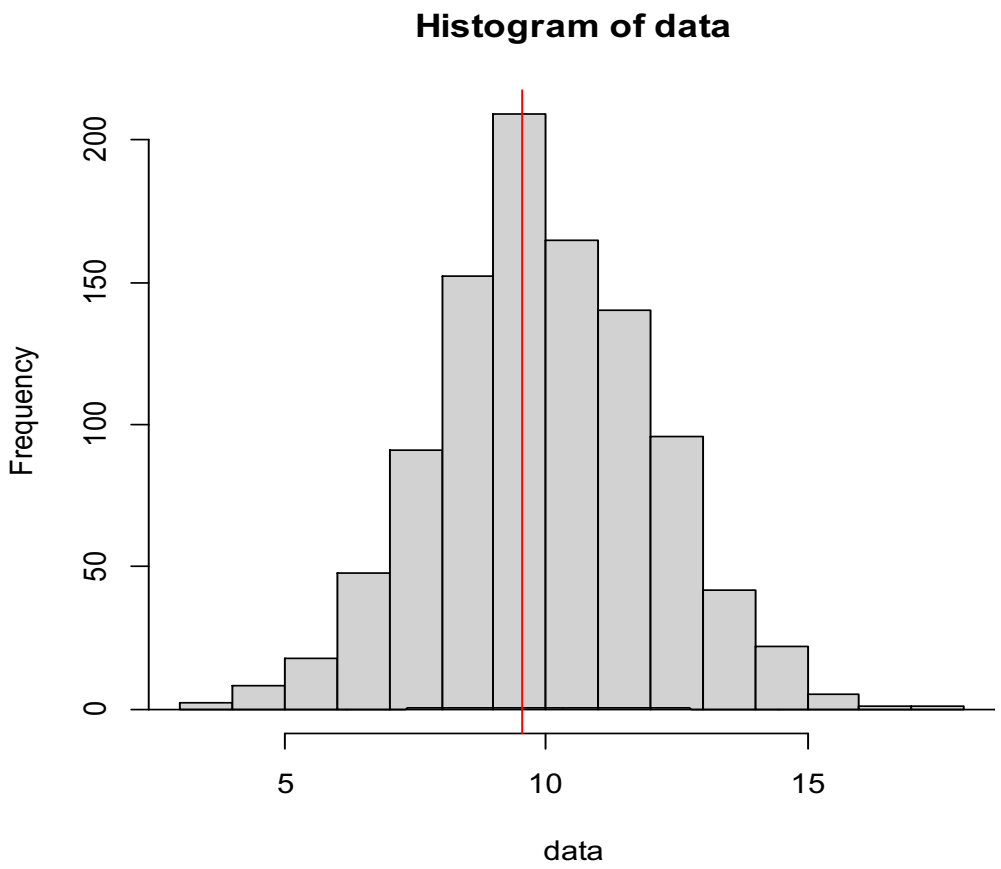


- Now do the same for “mpg” variable in R Studio with R Script!

- Check your value with the built-in function of model
- mode(df$mpg) **??**
- table(df$mgp) **??** (highest freq**?**)
- which.max(df$mpg) **??**

ChatGPT: how to locate mode graphically in r with histogram?

- # Generate some example data
- data <- rnorm(1000, mean = 10, sd = 2)
- # Create a histogram of the data
- hist(data)
- # Add a density line to the histogram
- lines(density(data))
- # Locate the mode
- density_values <- density(data)$y
- max_density <- max(density_values)
- mode <- density(data)$x[which.max(density_values)]
- # Add a vertical line at the mode location
- abline(v = mode, col = "red")



I AM NOT CONVINCED! ARE YOU? USE CHATGPT!

How to get **mode of a variable with bi-model or multi-model distribution** like “mpg”?

x	freq
10.4	**2**
13.3	1
14.3	1
14.7	1
15.0	1
15.2	**2**
15.5	1
15.8	1
16.4	1
17.3	1
17.8	1
18.1	1
18.7	1

x	freq
19.2	**2**
19.7	1
21.0	**2**
21.4	**2**
21.5	1
22.8	**2**
24.4	1
26.0	1
27.3	1
30.4	**2**
32.4	1
33.9	1

Mode = 3 Median – 2 Mean

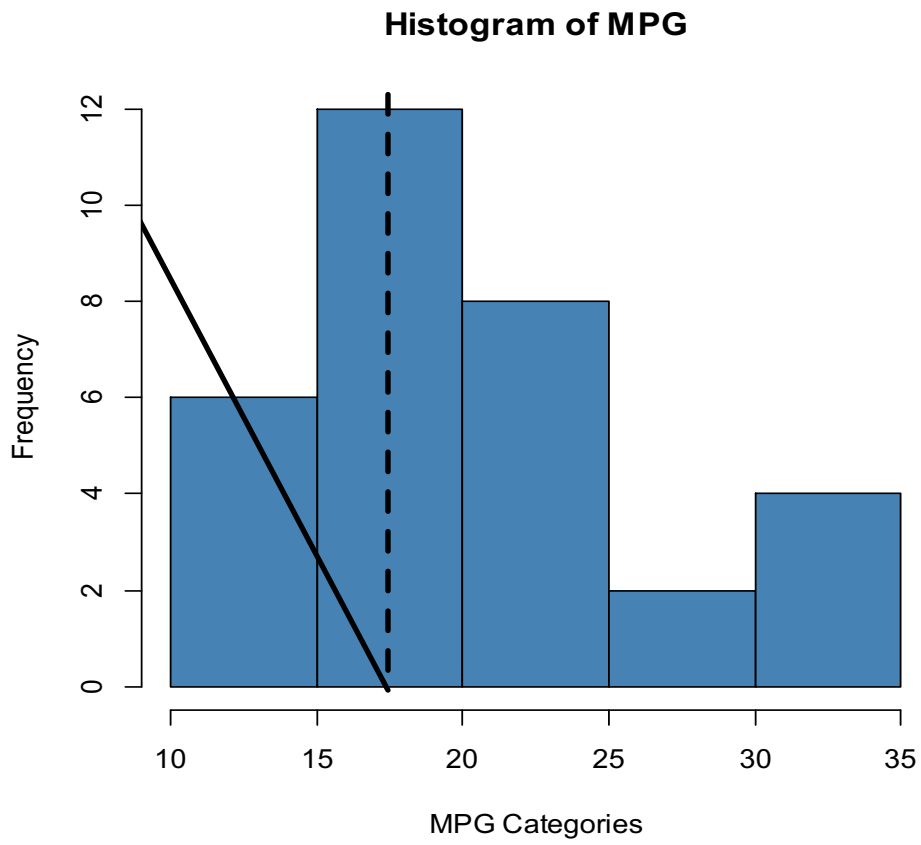
```
mode <- 3*median(df$mpg) - 2
*mean(df$mpg)

mode
[1] 17.41875 (How to interpret?)
```

Now show this value as “mode” in the histogram!

Histogram and abline of mode of “mpg”:

- hist(df$mpg, col = "steelblue", main = "Histogram of MPG", xlab = "MPG Categories")
- abline(**v**=3*median(df$mpg)-2*mean(df$mpg), lwd=3, lty=2)

- v = vertical “abline”
- h = horizontal “abline”



summary(df$mpg)

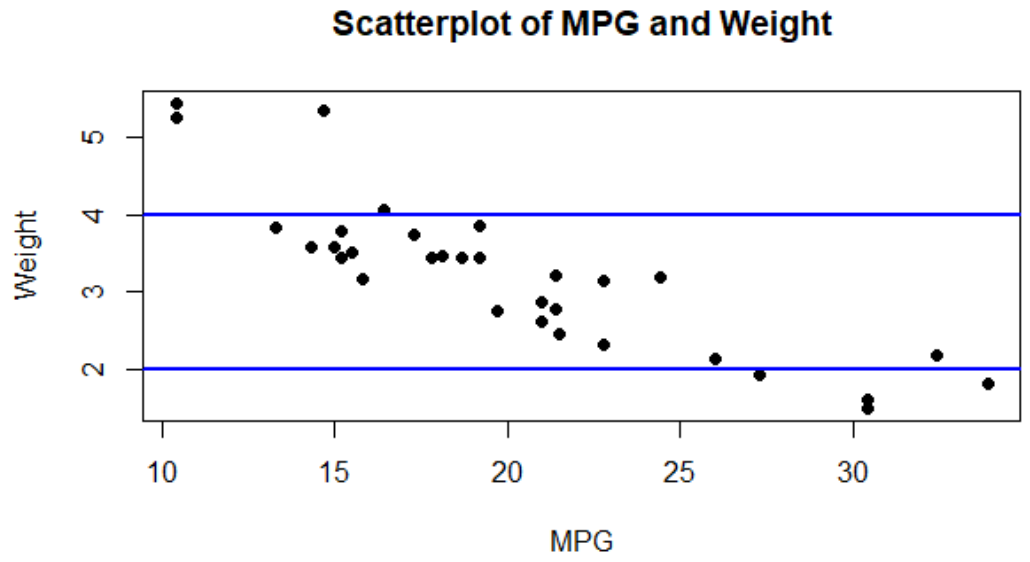
Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10.40	15.43	19.20	20.09	22.80	33.90

Assignment: Show the mode, median and mean of “mpg” variable in a single histogram

- With ablines of different colors
- With a legend for each color

Scatterplot with horizontal “abline”:

```
#Scatterplot with abline
plot(df$mpg, df$wt, pch=16, main = "Scatterplot of MPG and Weight", xlab = "MPG", ylab = "Weight")
abline(h=2, col = "blue", lwd=2)
abline(h=4, col = "blue", lwd=2)
```

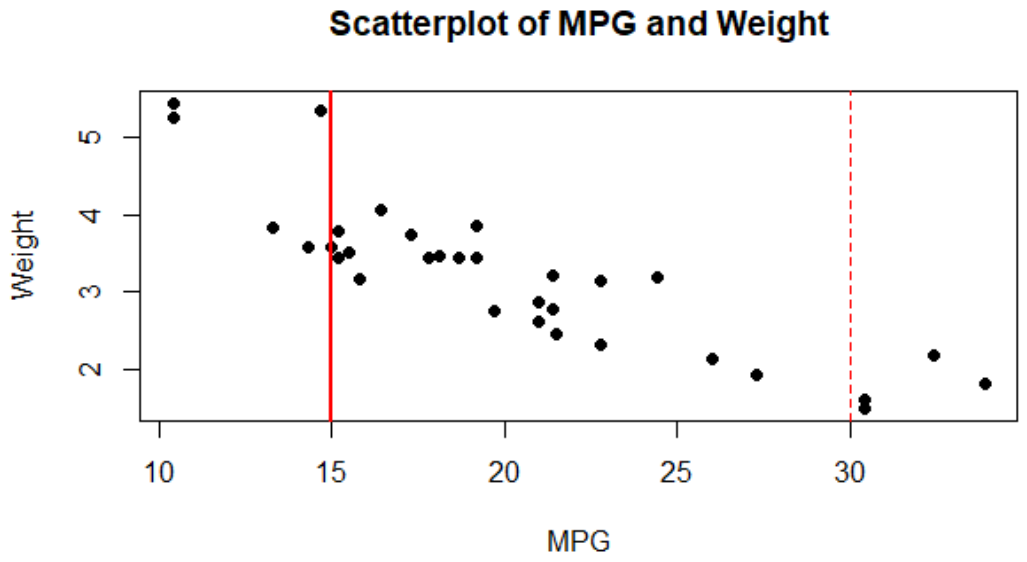


Here, h = horizontal line in y-axis and lwd = line width parameter

Scatterplot with vertical “abline”:

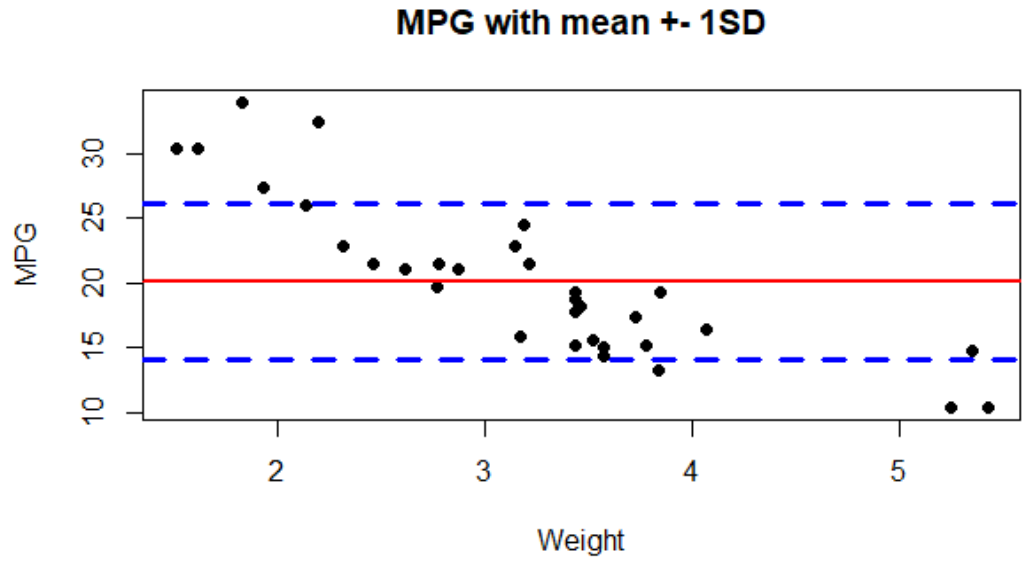
- plot(dfmpg, dfwt, pch=16, main = "Scatterplot of MPG and Weight", xlab = "MPG", ylab = "Weight")
- abline(v=15, col = "red", lwd=2)
- abline(v=30, col = "red", lty=2)

- Here, v=Vertical line at x-axis and lty = line type parameter



Scatterplot with mean ± 1*sd of y-variable:

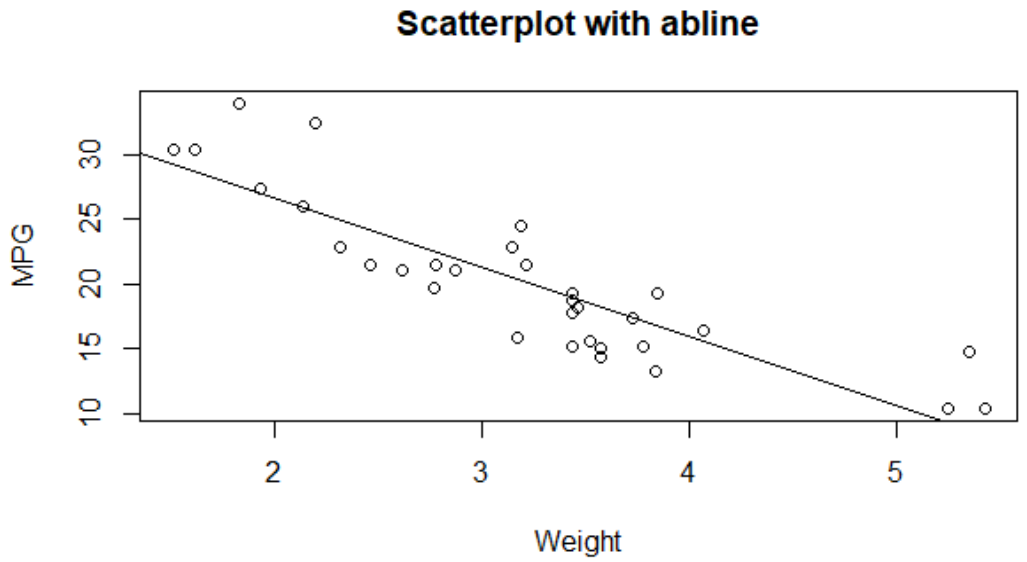
- plot(dfwt, dfmpg, pch=16)
- abline(h=mean(df$mpg), lwd = 2, col = "red")
- abline(h=mean(df$mpg) + 1*sd(df$mpg), col = "blue", lwd=3, lty = 2)
- abline(h=mean(df$mpg) - 1*sd(df$mpg), col = "blue", lwd=3, lty = 2)



Scatterplot with “abline” from a model:

- plot(dfwt, dfmpg, main = "Scatterplot with abline", xlab = "Weight", ylab = "MPG")
- reg_mod <- lm(df$mpg ~ df$wt)
- abline(reg_mod)

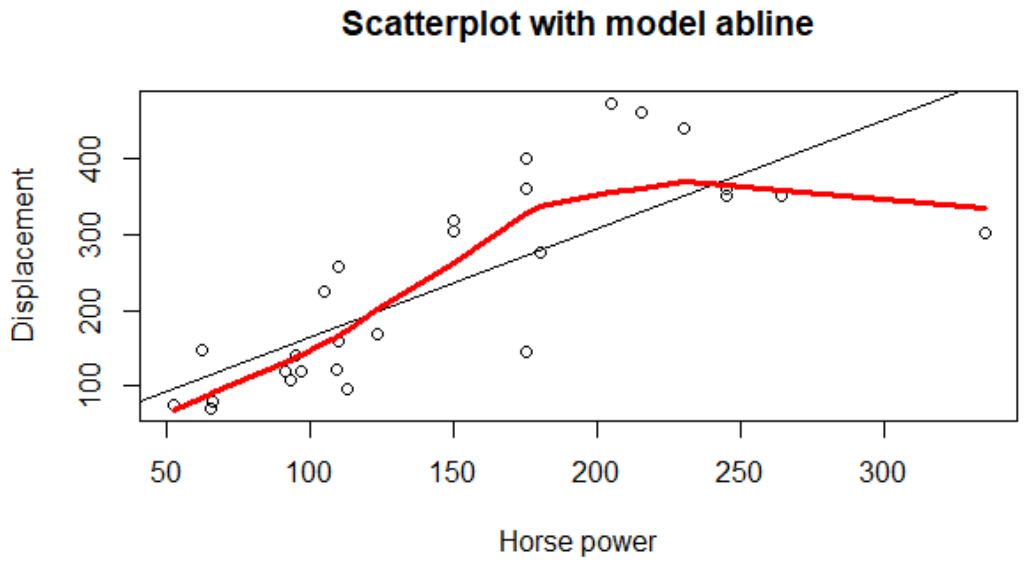
- plot(dfwt, dfmpg, main = "Scatterplot with abline", xlab = "Weight", ylab = "MPG")
- abline(lm(df$mpg ~ df$wt))



Scatterplot with “abline” and “lines” for a non-linear data:

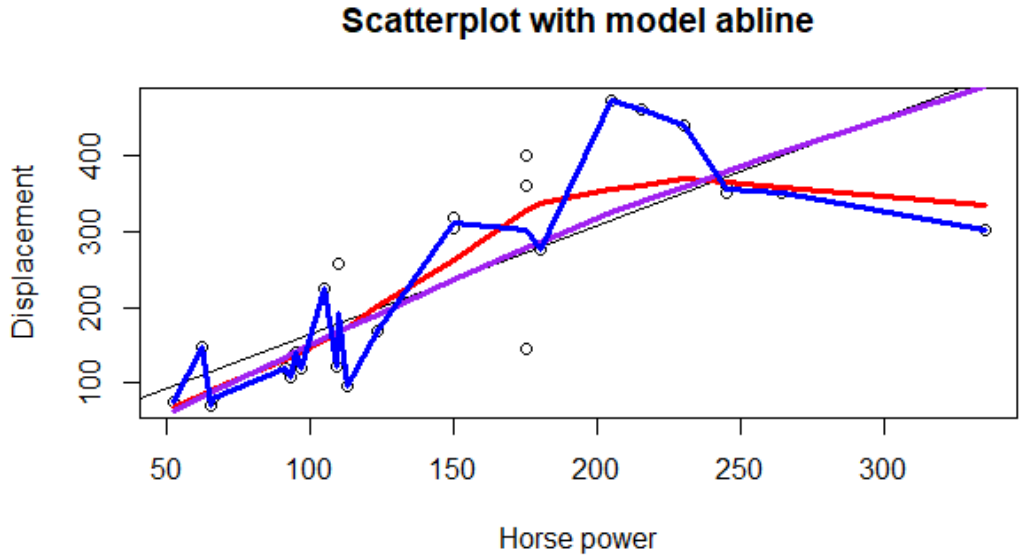
- plot(dfhp, dfdisp, main = "Scatterplot with model abline", xlab = "Horse power", ylab = "Displacement")
- abline(lm(df$disp ~ df$hp))
- lines(lowess(dfhp, dfdisp), col = "red", lwd = 3)

- **Lowess = Locally weighted Scatterplot Smoothing**



Scatterplot with “abline” and “**lines**” for a non-linear data: DO NOT OVERFIT!

- plot(dfhp, dfdisp, main = "Scatterplot with model abline", xlab = "Horse power", ylab = "Displacement")
- abline(lm(df$disp ~ df$hp))
- lines(lowess(dfhp, dfdisp), col = "red", lwd = 3)
- lines(lowess(dfhp, dfdisp, **f=1**), col = "purple", lwd = 3)
- lines(lowess(dfhp, dfdisp, **f=0.1**), col = "blue", lwd = 3)



More on plots: https://r-coder.com/plot-r/

- set.seed(1)

- # Generate sample data
- x <- rnorm(500)
- y <- x + rnorm(500)

- # Plot the data
- plot(x, y)

- # Equivalent
- M <- cbind(x, y)
- plot(M)

Function and arguments	Output plot
• plot(x,y)	• Scatterplot of x and y numeric vectors
• plot(factor)	• Barplot of the factor
• plot(factor, y)	• Boxplot of the numeric vector and the levels of the factor
• plot(time_series)	• Time series plot

Function and arguments	Output plot
• plot(date, y)	• Plots a date-based vector
• plot(function, lower, upper)	• Plot of the function between the lower and maximum value specified

Question/Queries?

Thank you!

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