C7081 Statistical Analysis for Data Science

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GITHUB LINK: [<https://github.com/satyaandrew/Assignment-C7081.git>]

*Data Source*

Dataset “new” was taken from Kaggle: [<https://www.kaggle.com/datasets/radhakrishna4/lung-capacity>]

Dataset “Diabetes” is taken from kaggle: [<https://www.kaggle.com/datasets/akshaydattatraykhare/diabetes-dataset>]

# Introduction

In this assignment I have taken 2 Datasets: 1. lung capacity dataset named “new” and 2. Diabetes Dataset

1.Lung capacity Dataset- “new” Dataset This data is showing lung closing capacity of smokers and non-smokers by age, gender and height. Here’s the meaning of variables: LungCap: It’s the lung closing capacity of the person, which means the smallest airways in which the respiratory bronchioles collapse. Age: how old is the person given data is in years in the dataset Height: It’s how tall is the person, given data is in Inches in the dataset Smoke: If the person smokes or doesn’t smoke Gender: the person male or female Cesarean: If they’re born by Cesarean

1. Diabetes Dataset

This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. The objective of the dataset is to diagnostically predict whether a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. In particular, all patients here are females at least 21 years old of Pima Indian heritage.

# Objective

1. I used these two datasets to run Regression and different models of regression on Dataset “new”

I have 6 variables in this dataset, the outcome variable is Lungcap which is the measure of lung capacity and 5 explanatory variables. I would like to relate lung capacity to the age of the child, height of the child, whether or not they identify as a smoker,their gender and whether or not they born via Caesarean using different statistical analysis techniques.

1. To run decision trees on diabetes dataset.

# Contents

1. Loading a new dataset.
2. Understanding the Dataset.
3. Basic commands.
4. Basic Graphics.
5. Simple linear regression.
6. Multiple regression.
7. Logistic regression.
8. Linear Discriminate Analysis.
9. Decision Trees.
10. Conclusion.

# 01. Loading new Dataset

## Choosing the working directory

setwd(“D:/Datasets/1”)

library(readxl)  
new <- read\_excel("new.xls")  
View(new)

# 02. Understanding the Dataset

This Dataset consists of 6 variables and it is about the Lung closing capacity of the individuals.

# 03. Basic commands

### length()

length(new)

## [1] 6

the length of the dataset, here in the dataset we have 6 columns so the length is shown as 6.

### ls()

ls(new)

## [1] "Age( years)" "Caesarean" "Gender" "Height(inches)"  
## [5] "LungCap(cc)" "Smoke"

ls() function gives us the list of objects in the dataset.

### Calculating the mean, variance, square root and standard deviation of the Lungcapacity column in the dataset:

mean(new$`LungCap(cc)`)

## [1] 7.863148

var(new$`LungCap(cc)`)

## [1] 7.086288

sqrt(new$`LungCap(cc)`)

## [1] 2.5446021 3.1819805 3.0903074 3.3354160 2.1908902 2.4949950 2.2248595  
## [8] 2.7064737 2.9790938 2.6076810 3.3911650 3.3052988 2.5544080 2.4494897  
## [15] 2.7973201 3.0862599 2.8062430 2.2472205 2.6504717 3.0862599 1.9937402  
## [22] 2.3075962 3.1662280 2.9538111 3.0618622 2.8896367 2.5980762 3.0041638  
## [29] 1.0606602 3.2365105 2.1563859 2.7793884 3.2557641 3.3203915 2.9410882  
## [36] 2.9706902 2.0493902 2.9622626 2.5149553 3.3652637 2.8679261 3.2749046  
## [43] 2.4238399 2.6972208 1.2549900 2.5884358 2.7658633 2.8284271 3.5986108  
## [50] 2.7110883 3.1024184 3.5249113 2.7202941 2.2079402 3.4964267 2.0615528  
## [57] 2.8635642 3.3763886 2.1505813 2.7973201 2.5884358 3.0331502 2.6362853  
## [64] 2.6172505 2.9068884 2.7110883 2.3184046 2.7156951 2.9325757 2.8106939  
## [71] 2.9154759 3.1144823 2.2638463 2.7973201 2.5000000 2.2304708 2.7386128  
## [78] 2.4238399 3.1701735 3.2863353 2.7110883 3.4496377 3.4713110 3.4022052  
## [85] 2.4899799 2.4748737 3.7249161 2.7838822 2.7340446 3.4022052 2.6362853  
## [92] 3.0331502 3.1224990 3.1064449 3.4278273 3.2901368 2.7477263 2.6362853  
## [99] 3.2672619 2.4698178 2.8328431 3.0372685 1.8574176 3.2749046 2.8195744  
## [106] 1.8506756 3.2977265 2.9368350 2.5396850 1.7606817 3.2287769 3.4856850  
## [113] 1.3601471 2.4238399 3.0207615 2.9958304 1.9364917 3.2054641 2.5836021  
## [120] 3.4314720 2.9240383 2.5396850 3.6331804 3.3985291 3.5986108 2.7973201  
## [127] 3.2480764 3.4205263 1.9104973 2.5787594 3.2287769 3.5951356 2.7294688  
## [134] 2.9325757 3.2634338 2.1737065 2.7477263 3.1898276 2.5396850 3.0781488  
## [141] 2.2304708 3.1464265 3.1937439 3.5213634 2.6172505 3.4387498 2.9368350  
## [148] 3.3689761 2.8679261 0.7120393 2.2527761 2.5396850 2.5932605 2.1272047  
## [155] 3.0454885 1.6881943 3.0577770 2.3558438 3.2171416 2.5739075 3.1184932  
## [162] 2.2135944 3.2365105 3.2939338 2.2693611 2.1035684 2.7477263 2.8896367  
## [169] 2.4596748 2.0796634 2.9748950 2.0796634 2.9622626 2.5396850 3.0290262  
## [176] 3.0740852 2.5884358 3.3090784 3.1384710 3.1344856 2.9154759 3.4460122  
## [183] 3.2365105 3.1503968 2.9154759 2.6832816 2.8939592 2.3452079 2.8151377  
## [190] 1.6955825 3.2171416 3.0536863 2.7294688 2.9368350 3.3503731 3.4820971  
## [197] 3.6090165 2.8017851 1.5968719 2.7522718 3.0903074 3.4964267 3.4095454  
## [204] 3.1622777 1.9748418 2.4186773 2.2416512 2.4392622 3.0781488 2.5298221  
## [211] 2.8679261 3.2825295 2.4799194 3.0659419 2.6925824 2.4186773 2.0310096  
## [218] 3.3052988 2.7110883 3.2365105 2.5641763 1.0839742 1.7175564 3.0000000  
## [225] 2.8460499 2.6972208 3.3279123 1.7606817 2.1679483 2.4186773 2.8151377  
## [232] 2.7018512 3.0454885 3.3354160 2.9368350 3.1344856 2.3926972 2.8151377  
## [239] 3.0781488 3.3015148 3.1104662 3.1543621 2.5641763 2.9325757 3.0822070  
## [246] 1.9557607 2.8284271 2.7340446 3.2710854 3.1819805 3.3503731 2.6972208  
## [253] 3.5355339 2.7613403 2.3021729 2.3664319 3.3241540 2.8328431 3.1543621  
## [260] 2.7202941 2.9748950 3.4460122 2.2022716 2.2748626 3.1898276 2.2858259  
## [267] 2.9958304 2.7110883 2.8240042 2.9622626 2.4698178 2.9664794 2.9495762  
## [274] 2.6410225 3.0618622 2.7202941 2.9664794 2.5884358 2.6925824 3.1184932  
## [281] 2.9154759 3.3128538 3.1144823 2.1851773 3.2132538 2.4899799 2.8284271  
## [288] 1.7392527 2.4748737 3.0903074 2.6551836 3.2326460 2.3398718 3.3763886  
## [295] 2.6739484 3.4928498 2.5932605 2.9538111 1.6201852 2.7202941 2.8635642  
## [302] 2.6172505 2.5592968 3.2442256 2.5739075 2.5592968 2.9111853 3.3052988  
## [309] 2.4647515 2.8896367 1.5732133 3.1104662 2.9622626 3.6193922 2.5495098  
## [316] 2.7018512 1.9748418 1.0124228 2.6028830 3.3128538 2.7613403 2.6879360  
## [323] 2.9832868 3.0248967 2.2803509 3.3279123 2.8853076 1.9039433 3.1024184  
## [330] 2.1213203 2.0371549 2.4494897 3.1701735 3.2787193 2.7156951 2.2912878  
## [337] 2.9790938 3.3015148 3.1304952 3.2015621 2.7248853 2.5149553 2.3558438  
## [344] 1.2747549 2.2472205 3.1780497 2.1737065 2.2416512 1.8506756 2.9111853  
## [351] 2.3769729 3.4168699 3.2557641 2.1737065 2.7522718 2.7838822 3.4205263  
## [358] 2.8853076 2.5787594 1.9170290 1.9937402 3.1701735 3.1937439 2.6972208  
## [365] 2.4596748 2.4949950 3.0495901 2.9958304 2.9410882 3.4132096 3.3279123  
## [372] 2.7748874 2.6315395 3.2749046 3.7914377 2.4849547 2.7973201 2.9368350  
## [379] 2.2135944 2.0493902 2.4186773 2.7156951 2.9622626 2.8284271 3.3279123  
## [386] 3.2557641 2.2693611 2.5446021 2.3184046 1.8439089 2.5544080 3.3652637  
## [393] 3.4132096 2.5932605 2.7883687 2.3874673 2.6124701 3.2403703 2.9538111  
## [400] 2.1154196 1.4142136 2.3075962 2.9025851 1.3784049 1.7958285 2.9622626  
## [407] 1.6278821 3.4856850 3.1780497 3.3911650 2.3769729 2.9453353 3.0454885  
## [414] 3.3166248 2.8504386 1.7818530 2.7294688 3.0166206 3.1424513 1.5000000  
## [421] 3.0041638 3.3503731 2.4392622 2.7928480 2.9240383 2.4238399 2.3291629  
## [428] 3.5035696 3.3503731 3.0740852 2.6504717 2.3452079 1.9748418 2.2472205  
## [435] 3.2326460 3.3615473 1.6955825 2.9025851 3.2403703 3.1503968 2.2912878  
## [442] 3.1224990 3.1304952 2.8809721 2.7748874 2.4799194 2.5099801 3.1384710  
## [449] 2.0796634 2.8151377 2.0856654 2.1035684 3.6159369 3.2326460 3.3948490  
## [456] 1.3874437 2.6124701 2.5641763 2.8240042 2.7748874 2.9325757 3.1583223  
## [463] 2.6692696 3.0983867 3.2710854 1.7818530 3.0166206 3.2054641 2.6457513  
## [470] 3.2249031 2.8017851 3.5531676 3.2634338 3.3203915 3.0083218 2.8416544  
## [477] 3.1104662 2.6362853 2.9025851 3.0862599 2.3822258 3.2210247 2.9958304  
## [484] 3.1104662 2.5099801 3.4058773 1.5411035 3.1780497 2.4647515 2.5932605  
## [491] 2.0615528 3.5916570 1.6955825 2.3184046 3.8307963 3.0000000 2.8896367  
## [498] 1.6507574 2.8504386 2.8106939 2.4698178 2.8284271 3.2557641 1.7102631  
## [505] 2.9325757 2.1154196 3.0166206 3.6571847 3.2093613 3.4713110 3.0041638  
## [512] 2.5884358 3.3911650 1.2942179 2.4949950 2.8416544 2.8766300 3.0536863  
## [519] 3.1464265 2.5446021 3.1184932 3.1384710 3.1937439 2.8722813 3.2249031  
## [526] 2.8896367 2.2858259 3.0000000 3.1024184 2.6551836 2.0186629 2.9154759  
## [533] 2.4031230 2.8591957 2.4647515 2.6267851 2.8151377 2.7477263 3.5106979  
## [540] 3.4568772 2.6076810 2.6172505 2.6315395 2.8062430 3.3429029 3.0943497  
## [547] 2.9025851 3.2825295 2.7613403 2.7658633 3.2093613 1.3322913 3.0041638  
## [554] 2.8328431 2.9283101 2.9748950 1.6507574 2.6645825 3.2519225 2.5641763  
## [561] 2.8106939 2.8766300 3.1937439 2.1330729 2.8284271 2.6879360 2.9495762  
## [568] 3.2710854 1.1510864 3.6571847 3.4496377 2.9368350 2.6267851 1.5000000  
## [575] 3.1662280 3.6124784 3.5106979 3.2710854 3.0166206 2.8679261 2.2693611  
## [582] 2.8284271 2.4596748 2.1095023 2.3130067 2.9706902 2.9874738 3.5178118  
## [589] 3.0781488 2.8896367 3.0248967 1.5000000 2.8328431 2.9495762 2.7973201  
## [596] 1.2041595 1.9811613 1.6807736 2.9958304 2.5049950 3.4351128 3.4351128  
## [603] 3.0618622 2.7703790 1.6278821 2.9283101 3.1424513 3.2901368 2.1965883  
## [610] 2.0615528 3.1224990 2.9240383 2.9325757 1.9235384 2.8766300 2.8504386  
## [617] 3.2672619 2.7658633 3.0290262 2.8722813 1.9170290 3.2596012 2.8635642  
## [624] 2.7703790 1.6507574 2.8896367 3.0372685 1.7102631 2.8896367 1.9235384  
## [631] 2.5347584 2.9622626 2.3769729 3.1937439 1.4230249 2.4849547 3.0083218  
## [638] 2.6457513 2.2416512 2.7477263 3.8144462 2.6410225 2.8195744 3.2977265  
## [645] 2.7064737 3.6571847 2.8017851 3.0166206 2.6124701 2.5396850 2.5592968  
## [652] 2.4849547 2.3611438 2.7928480 2.9832868 2.1505813 2.3717082 3.1662280  
## [659] 2.5495098 1.8027756 3.3503731 2.7064737 2.9025851 2.3558438 3.2249031  
## [666] 2.7973201 2.7477263 2.8372522 1.6201852 2.1389250 2.2304708 3.3578267  
## [673] 2.4748737 2.4392622 2.7340446 3.4820971 3.6503424 3.0331502 2.8504386  
## [680] 1.9811613 3.1662280 3.1344856 2.4135037 2.9197603 3.5637059 2.9664794  
## [687] 2.4799194 2.7340446 2.1095023 2.1679483 2.1035684 2.4899799 2.4596748  
## [694] 1.3964240 2.5980762 2.8722813 2.5248762 2.5396850 2.8195744 2.7248853  
## [701] 2.5690465 3.2249031 3.1104662 1.8973666 2.4949950 3.5249113 3.0290262  
## [708] 2.2967368 2.6267851 2.2022716 3.5106979 2.1505813 1.8506756 3.0536863  
## [715] 3.1503968 2.9538111 2.6598872 2.9706902 2.6786190 2.7064737 2.3926972  
## [722] 3.0083218 1.9621417 3.1344856 2.6645825

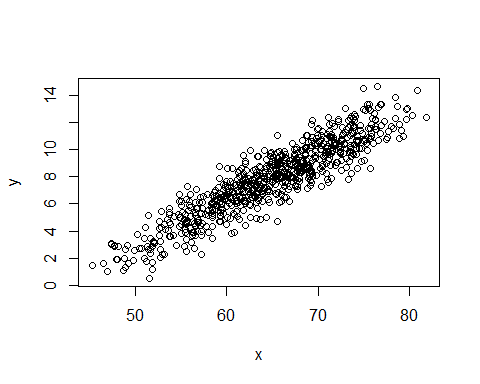
sd(new$`LungCap(cc)`)

## [1] 2.662008

# 04. Basic Graphics

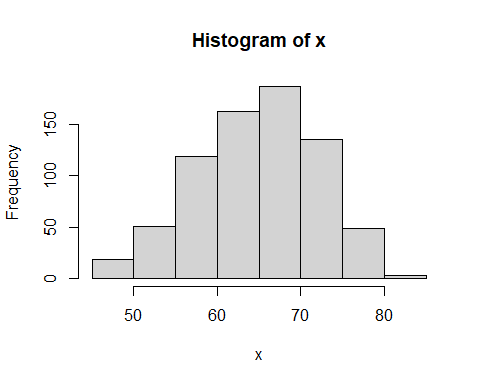
### Plot

y <- (new$`LungCap(cc)`)  
  
x <- (new$`Height(inches)`)  
  
plot(x,y)



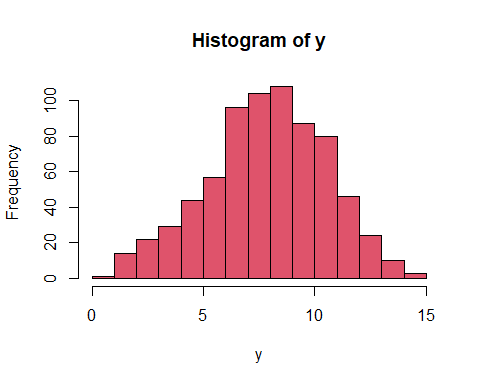
### Histogram

hist(x)



### Adding color for the histogram

hist(y, col = 2)



both the x and y are showing gaussian distribution.

### Summary

summary(new)

## LungCap(cc) Age( years) Height(inches) Smoke   
## Min. : 0.507 Min. : 3.00 Min. :45.30 Length:725   
## 1st Qu.: 6.150 1st Qu.: 9.00 1st Qu.:59.90 Class :character   
## Median : 8.000 Median :13.00 Median :65.40 Mode :character   
## Mean : 7.863 Mean :12.33 Mean :64.84   
## 3rd Qu.: 9.800 3rd Qu.:15.00 3rd Qu.:70.30   
## Max. :14.675 Max. :19.00 Max. :81.80   
## Gender Caesarean   
## Length:725 Length:725   
## Class :character Class :character   
## Mode :character Mode :character   
##   
##   
##

Summary function gives the numerical summary of all the variables in our dataset

### Summary of single variable

summary(new$`LungCap(cc)`)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 0.507 6.150 8.000 7.863 9.800 14.675

# 05. Simple linear regression

Simple linear regression is useful for examining the relationship between 2 numeric values.

When only two variables are involved in the functional relationship is known as simple regression and if the relationship between two variables is a straight line, it is known as simple linear regression.

In this model, I am fitting a simple linear regression model using Age as Independent or X-variable and lung capacity as the dependent variable denoted by y.

lm.fit <- lm(`LungCap(cc)`~`Age( years)`, data= new)  
attach(new)  
lm.fit <- lm(`LungCap(cc)`~ `Age( years)`)  
  
lm.fit

##   
## Call:  
## lm(formula = `LungCap(cc)` ~ `Age( years)`)  
##   
## Coefficients:  
## (Intercept) `Age( years)`   
## 1.1469 0.5448

## Summary of this model:

summary(lm.fit)

##   
## Call:  
## lm(formula = `LungCap(cc)` ~ `Age( years)`)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7799 -1.0203 -0.0005 0.9789 4.2650   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.14686 0.18353 6.249 7.06e-10 \*\*\*  
## `Age( years)` 0.54485 0.01416 38.476 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1.526 on 723 degrees of freedom  
## Multiple R-squared: 0.6719, Adjusted R-squared: 0.6714   
## F-statistic: 1480 on 1 and 723 DF, p-value: < 2.2e-16

The Median is close to 0, so we can say our model is not skewed

The residuals are symmetrically distributed as the Min and Max as well as 1Q and 3Q are close in magnitude.

In the summary, we got an R-squared value of 0.6719 which tells us that approximately 67% of the variation in Lung capacity can be explained by the Age factor

The F-statistic and P-value for an overall test of the significance of our model, this tests the Null Hypothesis that all the model coefficients are 0; here the slope for Age is 0.

The residual standard error gives an idea of how far observed Lung capacity (Y values) are from the predicted or fitted Lung capacity ( The Y-hats), this gives us an idea of a typical-sized residual or error.

The intercept 1.14686 is the estimated mean Y value when all X values are 0.

names(lm.fit)

## [1] "coefficients" "residuals" "effects" "rank"   
## [5] "fitted.values" "assign" "qr" "df.residual"   
## [9] "xlevels" "call" "terms" "model"

coef(lm.fit)

## (Intercept) `Age( years)`   
## 1.1468578 0.5448484

The predict function used to produce confidence intervals and prediction intervals for the prediction of Lungcapacity for a given value of Age

predict(lm.fit, data.frame( `Age( years)` = (c(5, 10, 15) )), interval = "confidence")

## Warning: 'newdata' had 3 rows but variables found have 725 rows

## fit lwr upr  
## 1 4.415948 4.207818 4.624079  
## 2 10.954129 10.761115 11.147143  
## 3 9.864432 9.713413 10.015451  
## 4 8.774735 8.654143 8.895328  
## 5 3.871100 3.638997 4.103202  
## 6 7.140190 7.022973 7.257407  
## 7 5.505645 5.341787 5.669503  
## 8 7.140190 7.022973 7.257407  
## 9 9.319584 9.185786 9.453381  
## 10 7.140190 7.022973 7.257407  
## 11 11.498977 11.282651 11.715303  
## 12 10.409280 10.238232 10.580329  
## 13 7.685039 7.573407 7.796670  
## 14 6.595342 6.466641 6.724042  
## 15 6.595342 6.466641 6.724042  
## 16 8.229887 8.117064 8.342710  
## 17 9.319584 9.185786 9.453381  
## 18 5.505645 5.341787 5.669503  
## 19 7.140190 7.022973 7.257407  
## 20 8.774735 8.654143 8.895328  
## 21 4.415948 4.207818 4.624079  
## 22 5.505645 5.341787 5.669503  
## 23 9.864432 9.713413 10.015451  
## 24 7.140190 7.022973 7.257407  
## 25 7.140190 7.022973 7.257407  
## 26 7.685039 7.573407 7.796670  
## 27 7.685039 7.573407 7.796670  
## 28 6.050493 5.905808 6.195178  
## 29 3.326251 3.069404 3.583099  
## 30 10.954129 10.761115 11.147143  
## 31 3.326251 3.069404 3.583099  
## 32 8.229887 8.117064 8.342710  
## 33 8.229887 8.117064 8.342710  
## 34 8.229887 8.117064 8.342710  
## 35 7.685039 7.573407 7.796670  
## 36 6.595342 6.466641 6.724042  
## 37 4.415948 4.207818 4.624079  
## 38 6.050493 5.905808 6.195178  
## 39 7.140190 7.022973 7.257407  
## 40 10.409280 10.238232 10.580329  
## 41 8.774735 8.654143 8.895328  
## 42 10.409280 10.238232 10.580329  
## 43 5.505645 5.341787 5.669503  
## 44 7.685039 7.573407 7.796670  
## 45 4.415948 4.207818 4.624079  
## 46 7.140190 7.022973 7.257407  
## 47 7.140190 7.022973 7.257407  
## 48 7.685039 7.573407 7.796670  
## 49 10.409280 10.238232 10.580329  
## 50 4.960797 4.775564 5.146029  
## 51 9.319584 9.185786 9.453381  
## 52 9.319584 9.185786 9.453381  
## 53 7.140190 7.022973 7.257407  
## 54 6.595342 6.466641 6.724042  
## 55 10.954129 10.761115 11.147143  
## 56 4.415948 4.207818 4.624079  
## 57 8.229887 8.117064 8.342710  
## 58 11.498977 11.282651 11.715303  
## 59 6.050493 5.905808 6.195178  
## 60 7.685039 7.573407 7.796670  
## 61 7.685039 7.573407 7.796670  
## 62 8.774735 8.654143 8.895328  
## 63 6.050493 5.905808 6.195178  
## 64 8.229887 8.117064 8.342710  
## 65 8.229887 8.117064 8.342710  
## 66 8.229887 8.117064 8.342710  
## 67 7.140190 7.022973 7.257407  
## 68 7.140190 7.022973 7.257407  
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## 723 7.140190 7.022973 7.257407  
## 724 9.319584 9.185786 9.453381  
## 725 6.595342 6.466641 6.724042

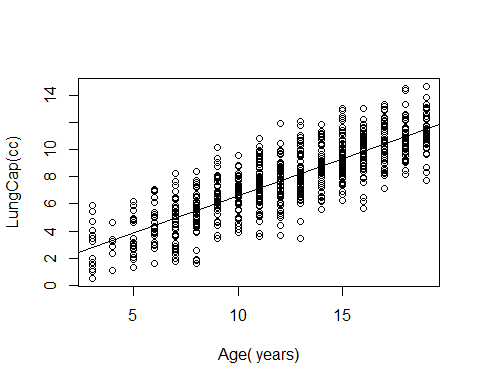
predict(lm.fit, data.frame( `Age( years)` = (c(5, 10, 15) )), interval = "prediction")

## Warning: 'newdata' had 3 rows but variables found have 725 rows

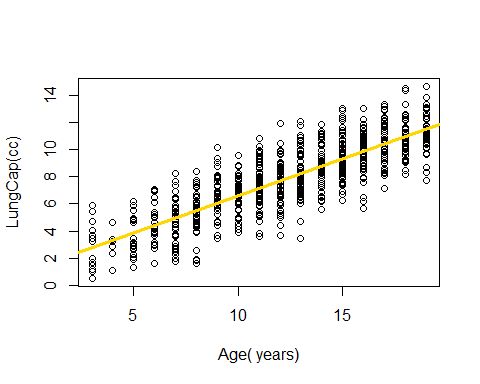
## fit lwr upr  
## 1 4.415948 1.4129447 7.418952  
## 2 10.954129 7.9521352 13.956123  
## 3 9.864432 6.8648457 12.864018  
## 4 8.774735 5.7765268 11.772944  
## 5 3.871100 0.8663397 6.875860  
## 6 7.140190 4.1421155 10.138265  
## 7 5.505645 2.5053848 8.505905  
## 8 7.140190 4.1421155 10.138265  
## 9 9.319584 6.3208151 12.318352  
## 10 7.140190 4.1421155 10.138265  
## 11 11.498977 8.4953946 14.502560  
## 12 10.409280 7.4086190 13.409942  
## 13 7.685039 4.6871771 10.682900  
## 14 6.595342 3.5967962 9.593887  
## 15 6.595342 3.5967962 9.593887  
## 16 8.229887 5.2319809 11.227793  
## 17 9.319584 6.3208151 12.318352  
## 18 5.505645 2.5053848 8.505905  
## 19 7.140190 4.1421155 10.138265  
## 20 8.774735 5.7765268 11.772944  
## 21 4.415948 1.4129447 7.418952  
## 22 5.505645 2.5053848 8.505905  
## 23 9.864432 6.8648457 12.864018  
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## 25 7.140190 4.1421155 10.138265  
## 26 7.685039 4.6871771 10.682900  
## 27 7.685039 4.6871771 10.682900  
## 28 6.050493 3.0512192 9.049767  
## 29 3.326251 0.3194786 6.333024  
## 30 10.954129 7.9521352 13.956123  
## 31 3.326251 0.3194786 6.333024  
## 32 8.229887 5.2319809 11.227793  
## 33 8.229887 5.2319809 11.227793  
## 34 8.229887 5.2319809 11.227793  
## 35 7.685039 4.6871771 10.682900  
## 36 6.595342 3.5967962 9.593887  
## 37 4.415948 1.4129447 7.418952  
## 38 6.050493 3.0512192 9.049767  
## 39 7.140190 4.1421155 10.138265  
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## 41 8.774735 5.7765268 11.772944  
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## 43 5.505645 2.5053848 8.505905  
## 44 7.685039 4.6871771 10.682900  
## 45 4.415948 1.4129447 7.418952  
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## 73 7.140190 4.1421155 10.138265  
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## 85 8.774735 5.7765268 11.772944  
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## 88 7.140190 4.1421155 10.138265  
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## 98 4.960797 1.9592932 7.962300  
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## 114 2.781403 -0.2276379 5.790444  
## 115 9.319584 6.3208151 12.318352  
## 116 9.319584 6.3208151 12.318352  
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## 118 10.954129 7.9521352 13.956123  
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## 604 8.774735 5.7765268 11.772944  
## 605 4.960797 1.9592932 7.962300  
## 606 9.864432 6.8648457 12.864018  
## 607 9.864432 6.8648457 12.864018  
## 608 9.864432 6.8648457 12.864018  
## 609 4.960797 1.9592932 7.962300  
## 610 4.960797 1.9592932 7.962300  
## 611 9.864432 6.8648457 12.864018  
## 612 9.319584 6.3208151 12.318352  
## 613 7.685039 4.6871771 10.682900  
## 614 4.415948 1.4129447 7.418952  
## 615 7.140190 4.1421155 10.138265  
## 616 8.229887 5.2319809 11.227793  
## 617 9.319584 6.3208151 12.318352  
## 618 8.229887 5.2319809 11.227793  
## 619 10.954129 7.9521352 13.956123  
## 620 9.319584 6.3208151 12.318352  
## 621 2.781403 -0.2276379 5.790444  
## 622 9.864432 6.8648457 12.864018  
## 623 7.685039 4.6871771 10.682900  
## 624 7.685039 4.6871771 10.682900  
## 625 3.871100 0.8663397 6.875860  
## 626 7.685039 4.6871771 10.682900  
## 627 8.774735 5.7765268 11.772944  
## 628 4.415948 1.4129447 7.418952  
## 629 11.498977 8.4953946 14.502560  
## 630 6.050493 3.0512192 9.049767  
## 631 7.140190 4.1421155 10.138265  
## 632 6.595342 3.5967962 9.593887  
## 633 4.960797 1.9592932 7.962300  
## 634 9.864432 6.8648457 12.864018  
## 635 3.871100 0.8663397 6.875860  
## 636 5.505645 2.5053848 8.505905  
## 637 9.319584 6.3208151 12.318352  
## 638 6.595342 3.5967962 9.593887  
## 639 6.595342 3.5967962 9.593887  
## 640 8.229887 5.2319809 11.227793  
## 641 10.954129 7.9521352 13.956123  
## 642 7.685039 4.6871771 10.682900  
## 643 8.229887 5.2319809 11.227793  
## 644 11.498977 8.4953946 14.502560  
## 645 6.595342 3.5967962 9.593887  
## 646 11.498977 8.4953946 14.502560  
## 647 9.864432 6.8648457 12.864018  
## 648 8.229887 5.2319809 11.227793  
## 649 8.229887 5.2319809 11.227793  
## 650 8.774735 5.7765268 11.772944  
## 651 6.050493 3.0512192 9.049767  
## 652 5.505645 2.5053848 8.505905  
## 653 6.595342 3.5967962 9.593887  
## 654 8.229887 5.2319809 11.227793  
## 655 7.685039 4.6871771 10.682900  
## 656 4.415948 1.4129447 7.418952  
## 657 8.774735 5.7765268 11.772944  
## 658 10.954129 7.9521352 13.956123  
## 659 8.774735 5.7765268 11.772944  
## 660 2.781403 -0.2276379 5.790444  
## 661 9.864432 6.8648457 12.864018  
## 662 6.595342 3.5967962 9.593887  
## 663 7.685039 4.6871771 10.682900  
## 664 6.595342 3.5967962 9.593887  
## 665 9.864432 6.8648457 12.864018  
## 666 6.595342 3.5967962 9.593887  
## 667 5.505645 2.5053848 8.505905  
## 668 6.595342 3.5967962 9.593887  
## 669 3.871100 0.8663397 6.875860  
## 670 5.505645 2.5053848 8.505905  
## 671 5.505645 2.5053848 8.505905  
## 672 10.954129 7.9521352 13.956123  
## 673 4.415948 1.4129447 7.418952  
## 674 6.595342 3.5967962 9.593887  
## 675 8.774735 5.7765268 11.772944  
## 676 10.409280 7.4086190 13.409942  
## 677 10.954129 7.9521352 13.956123  
## 678 8.774735 5.7765268 11.772944  
## 679 8.774735 5.7765268 11.772944  
## 680 6.595342 3.5967962 9.593887  
## 681 8.229887 5.2319809 11.227793  
## 682 10.954129 7.9521352 13.956123  
## 683 7.140190 4.1421155 10.138265  
## 684 9.319584 6.3208151 12.318352  
## 685 11.498977 8.4953946 14.502560  
## 686 9.864432 6.8648457 12.864018  
## 687 9.864432 6.8648457 12.864018  
## 688 9.319584 6.3208151 12.318352  
## 689 5.505645 2.5053848 8.505905  
## 690 4.960797 1.9592932 7.962300  
## 691 7.685039 4.6871771 10.682900  
## 692 6.595342 3.5967962 9.593887  
## 693 8.229887 5.2319809 11.227793  
## 694 4.960797 1.9592932 7.962300  
## 695 8.229887 5.2319809 11.227793  
## 696 8.774735 5.7765268 11.772944  
## 697 6.050493 3.0512192 9.049767  
## 698 9.864432 6.8648457 12.864018  
## 699 9.319584 6.3208151 12.318352  
## 700 8.229887 5.2319809 11.227793  
## 701 6.595342 3.5967962 9.593887  
## 702 8.774735 5.7765268 11.772944  
## 703 7.685039 4.6871771 10.682900  
## 704 4.960797 1.9592932 7.962300  
## 705 9.319584 6.3208151 12.318352  
## 706 11.498977 8.4953946 14.502560  
## 707 9.319584 6.3208151 12.318352  
## 708 7.685039 4.6871771 10.682900  
## 709 9.319584 6.3208151 12.318352  
## 710 6.595342 3.5967962 9.593887  
## 711 10.409280 7.4086190 13.409942  
## 712 3.871100 0.8663397 6.875860  
## 713 2.781403 -0.2276379 5.790444  
## 714 8.774735 5.7765268 11.772944  
## 715 9.864432 6.8648457 12.864018  
## 716 11.498977 8.4953946 14.502560  
## 717 7.140190 4.1421155 10.138265  
## 718 9.864432 6.8648457 12.864018  
## 719 10.409280 7.4086190 13.409942  
## 720 6.050493 3.0512192 9.049767  
## 721 6.050493 3.0512192 9.049767  
## 722 10.954129 7.9521352 13.956123  
## 723 7.140190 4.1421155 10.138265  
## 724 9.319584 6.3208151 12.318352  
## 725 6.595342 3.5967962 9.593887

Now plot Age and LungCap(cc) along with the least squares regression line using the plot() and abline() functions.

plot(`Age( years)` , `LungCap(cc)`)  
abline(lm.fit)

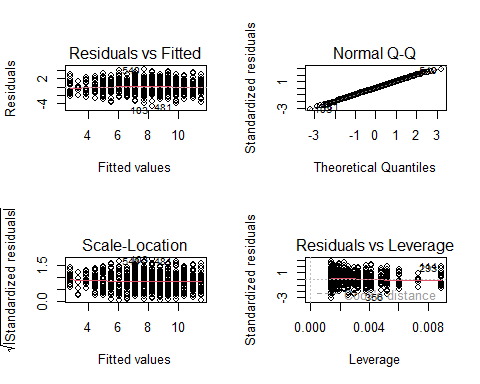
 This gives us the visual evidence for linearity in the relationship between Age and LungCap(cc)

plot(`Age( years)` , `LungCap(cc)`)  
  
abline(lm.fit, lwd =3, col = "Gold")



## Diagnostics plots

par(mfrow = c(2, 2))  
plot(lm.fit)

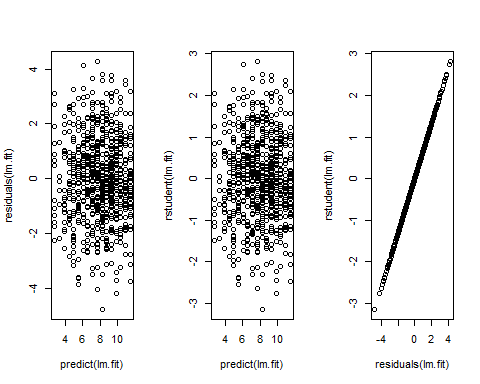


Linearity is clearly seen in the Diagnostic plots as the red line is flat.

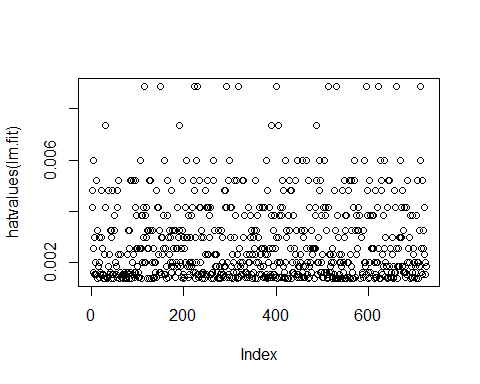
In the Q-Q plot, the residuals are in a diagonal line which tells us the Y values are normally distributed.

The function rstudent() will return the studentized residuals, and we can use this function to plot the residuals against the ﬁtted values.

par(mfrow = c(1, 3))  
plot(predict(lm.fit), residuals(lm.fit))  
plot(predict(lm.fit), rstudent(lm.fit))  
plot(residuals(lm.fit), rstudent(lm.fit))

 On the basis of the residual plots, we can say the data is linear.

par(mfrow = c(1, 1))  
plot(hatvalues(lm.fit))



which.max(hatvalues(lm.fit))

## 114   
## 114

The which.max() function identiﬁes the index of the largest element of a vector. In this case, it tells us which observation has the largest leverage statistic.

### Predicting the Lung Capacity based on the variable Age, Based on the summary we create an equation

Based on the summary we create an equation with the intercept and coefficient values.

Y <- (1.14686) + (0.54485\*20)  
  
Y

## [1] 12.04386

we took the Intercept and assumed the age of the individual as 20 and predicted the Lung capacity of 12.04386cc.

# 06. Multiple regression

In multiple regression, more than one X variable is used to determine y.

Here, I used Age and height as explanatory X variables.

lm.fit2 <- lm(`LungCap(cc)` ~ `Age( years)`+ `Height(inches)` , data = new)  
summary(lm.fit2)

##   
## Call:  
## lm(formula = `LungCap(cc)` ~ `Age( years)` + `Height(inches)`,   
## data = new)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.4080 -0.7097 -0.0078 0.7167 3.1679   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -11.747065 0.476899 -24.632 < 2e-16 \*\*\*  
## `Age( years)` 0.126368 0.017851 7.079 3.45e-12 \*\*\*  
## `Height(inches)` 0.278432 0.009926 28.051 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1.056 on 722 degrees of freedom  
## Multiple R-squared: 0.843, Adjusted R-squared: 0.8425   
## F-statistic: 1938 on 2 and 722 DF, p-value: < 2.2e-16

In summary, with the Multiple R squared value, we can say that approximately 84% of the variation in Lung capacity can be explained by Age and Height in this model.

The null hypothesis is 0,and the slope for age and height is 0 by F-statistic and p-value.

The residual standard error gives an idea of how far observed lung capacity Y values are from the predicted lung capacity Y Hats.

Intercept -11.747 is the estimated mean y value when all X values are 0, that is the estimated mean lung capacity for someone with age and height of 0 value

The slope for Age 0.126 is the effect of age on lung capacity adjusting or controlling for height, so with one year increase in Age an increase of 0.126 in lung capacity adjusting or controlling for height, the hypothesis test for the slope for Age = 0

The slope for height is 0.278 is the estimated effect of height on lung capacity adjusting for age, the test for the hypothesis, the slope is 0.

### Correlation between age and height in Pearsons method:

cor(`Age( years)`, `Height(inches)` , method = "pearson")

## [1] 0.8357368

By correlation, we can observe that age and height are very highly correlated, the high value of correlation between age and height shows that these two effects are somewhat bounded together.

### Predicting the lung capacity based on this model

y = a + b1x1 + b2x2 +…+ bnxn

y <- (-11.747065) + (0.126368\*22) + (0.278432\*90)  
  
y

## [1] 16.09191

Here I took the intercepts and assumed the age as 20 years and height as 90 inches and predicted the lung capacity 16.09191 using the intercepts.

## ANOVA

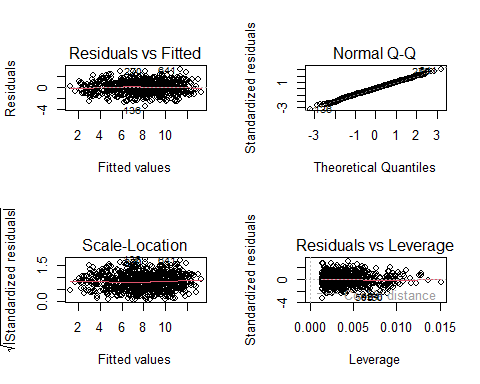
lm.fit <- lm(`LungCap(cc)`~ `Age( years)`)  
anova(lm.fit, lm.fit2)

## Analysis of Variance Table  
##   
## Model 1: `LungCap(cc)` ~ `Age( years)`  
## Model 2: `LungCap(cc)` ~ `Age( years)` + `Height(inches)`  
## Res.Df RSS Df Sum of Sq F Pr(>F)   
## 1 723 1683.48   
## 2 722 805.57 1 877.91 786.84 < 2.2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

The ANOVA() function performs a hypothesis test comparing the two models. The F-statistic value of 786.84 and the associated P value is 0, this gives clear evidence that model 2 is superior yo model 1.

## Diagnostic plots

par(mfrow = c(2, 2))  
plot(lm.fit2)



par(mfrow = c(1, 1))

For checking the non-linearity in the relationship between Lung capacity and Height, we have these residual plots. we can see that the X values are Linear.

# 07.Logistic regression

glm.fit <- glm(`LungCap(cc)`~., data = new)  
  
glm.fit

##   
## Call: glm(formula = `LungCap(cc)` ~ ., data = new)  
##   
## Coefficients:  
## (Intercept) `Age( years)` `Height(inches)` Smokeyes   
## -11.3225 0.1605 0.2641 -0.6096   
## Gendermale Caesareanyes   
## 0.3870 -0.2142   
##   
## Degrees of Freedom: 724 Total (i.e. Null); 719 Residual  
## Null Deviance: 5130   
## Residual Deviance: 747.8 AIC: 2094

summary(glm.fit)

##   
## Call:  
## glm(formula = `LungCap(cc)` ~ ., data = new)  
##   
## Deviance Residuals:   
## Min 1Q Median 3Q Max   
## -3.3388 -0.7200 0.0444 0.7093 3.0172   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -11.32249 0.47097 -24.041 < 2e-16 \*\*\*  
## `Age( years)` 0.16053 0.01801 8.915 < 2e-16 \*\*\*  
## `Height(inches)` 0.26411 0.01006 26.248 < 2e-16 \*\*\*  
## Smokeyes -0.60956 0.12598 -4.839 1.60e-06 \*\*\*  
## Gendermale 0.38701 0.07966 4.858 1.45e-06 \*\*\*  
## Caesareanyes -0.21422 0.09074 -2.361 0.0185 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## (Dispersion parameter for gaussian family taken to be 1.040025)  
##   
## Null deviance: 5130.47 on 724 degrees of freedom  
## Residual deviance: 747.78 on 719 degrees of freedom  
## AIC: 2093.9  
##   
## Number of Fisher Scoring iterations: 2

In summary, it shows that if the Gender is male and Smoking, age and height are significant in impacting the lung closing capacity of the child.

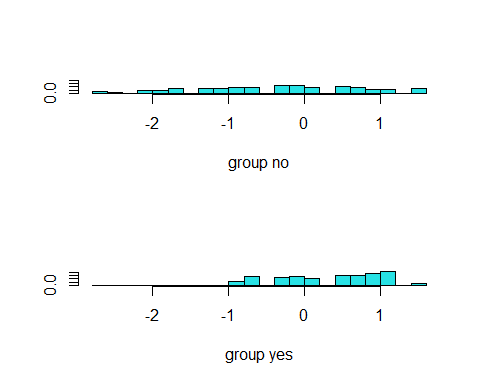
# 08. Linear Discriminant Analysis (LDA)

Linear Discriminant Analysis (LDA) is used to explore differences between data with two or more classes.

library(MASS)  
  
lda.fit <- lda(Smoke ~ `Age( years)`, data = new)  
lda.fit

## Call:  
## lda(Smoke ~ `Age( years)`, data = new)  
##   
## Prior probabilities of groups:  
## no yes   
## 0.8937931 0.1062069   
##   
## Group means:  
## `Age( years)`  
## no 12.03549  
## yes 14.77922  
##   
## Coefficients of linear discriminants:  
## LD1  
## `Age( years)` 0.2552914

plot(lda.fit)



lda.pred = predict(lda.fit, new)  
names(lda.pred)

## [1] "class" "posterior" "x"

It shows that 89% of the individuals are not smoking and the rest 10% are smoking in our dataset. In the group it shows the age below 12.03 are not smoking and the age above 14.77 are smoking in our given dataset

lda.pred = predict(lda.fit, new)  
names(lda.pred)

## [1] "class" "posterior" "x"

lda.class = lda.pred$class  
table(lda.class, Smoke)

## Smoke  
## lda.class no yes  
## no 648 77  
## yes 0 0

Out of 725 total individuals, 648 are non-smoking and 77 are smoking

mean(lda.class == Smoke)

## [1] 0.8937931

Calculate the mean that is 0.8937

sum( lda.pred$posterior[, 1] >= .5)

## [1] 725

Applying a 50% threshold to the posterior probabilities allows us to recreate the predictions contained in lda.pred$class.

sum( lda.pred$posterior[, 1] < .5)

## [1] 0

lda.pred$posterior[1:20, 1]

## 1 2 3 4 5 6 7 8   
## 0.9693698 0.7873180 0.8411049 0.8833053 0.9742562 0.9282802 0.9567698 0.9282802   
## 9 10 11 12 13 14 15 16   
## 0.8635732 0.9282802 0.7558417 0.8157257 0.9154248 0.9393110 0.9393110 0.9005122   
## 17 18 19 20   
## 0.8635732 0.9567698 0.9282802 0.8833053

lda.class[1:20]

## [1] no no no no no no no no no no no no no no no no no no no no  
## Levels: no yes

sum(lda.pred$posterior[ , 1] > .9)

## [1] 428

by this prediction there is probability of an increase in the number of smokers by the age can be predicted.

# 09. Decision trees

Decision tree is a graph to represent results in the form of a tree.

library(rpart)

## Warning: package 'rpart' was built under R version 4.2.2

library(rpart.plot)

## Warning: package 'rpart.plot' was built under R version 4.2.2

## Load the diabetes dataset

Dataset 2: “diabetes” - this dataset is about the outcome of diabetes based on different functions # About this data, dataset is taken from Kaggle <https://www.kaggle.com/datasets/akshaydattatraykhare/diabetes-dataset>

diabetes <- read.csv("D:/Datasets/maybe/diabetes.csv")  
  
summary(diabetes)

## Pregnancies Glucose BloodPressure SkinThickness   
## Min. : 0.000 Min. : 0.0 Min. : 0.00 Min. : 0.00   
## 1st Qu.: 1.000 1st Qu.: 99.0 1st Qu.: 62.00 1st Qu.: 0.00   
## Median : 3.000 Median :117.0 Median : 72.00 Median :23.00   
## Mean : 3.845 Mean :120.9 Mean : 69.11 Mean :20.54   
## 3rd Qu.: 6.000 3rd Qu.:140.2 3rd Qu.: 80.00 3rd Qu.:32.00   
## Max. :17.000 Max. :199.0 Max. :122.00 Max. :99.00   
## Insulin BMI DiabetesPedigreeFunction Age   
## Min. : 0.0 Min. : 0.00 Min. :0.0780 Min. :21.00   
## 1st Qu.: 0.0 1st Qu.:27.30 1st Qu.:0.2437 1st Qu.:24.00   
## Median : 30.5 Median :32.00 Median :0.3725 Median :29.00   
## Mean : 79.8 Mean :31.99 Mean :0.4719 Mean :33.24   
## 3rd Qu.:127.2 3rd Qu.:36.60 3rd Qu.:0.6262 3rd Qu.:41.00   
## Max. :846.0 Max. :67.10 Max. :2.4200 Max. :81.00   
## Outcome   
## Min. :0.000   
## 1st Qu.:0.000   
## Median :0.000   
## Mean :0.349   
## 3rd Qu.:1.000   
## Max. :1.000

str(diabetes)

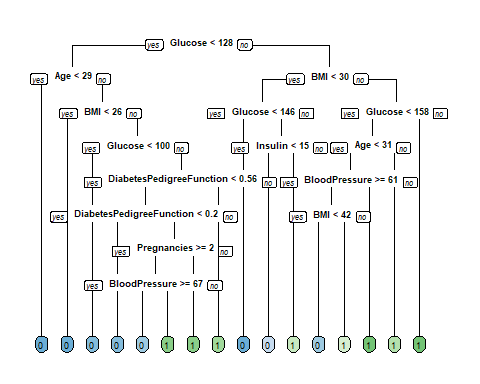
## 'data.frame': 768 obs. of 9 variables:  
## $ Pregnancies : int 6 1 8 1 0 5 3 10 2 8 ...  
## $ Glucose : int 148 85 183 89 137 116 78 115 197 125 ...  
## $ BloodPressure : int 72 66 64 66 40 74 50 0 70 96 ...  
## $ SkinThickness : int 35 29 0 23 35 0 32 0 45 0 ...  
## $ Insulin : int 0 0 0 94 168 0 88 0 543 0 ...  
## $ BMI : num 33.6 26.6 23.3 28.1 43.1 25.6 31 35.3 30.5 0 ...  
## $ DiabetesPedigreeFunction: num 0.627 0.351 0.672 0.167 2.288 ...  
## $ Age : int 50 31 32 21 33 30 26 29 53 54 ...  
## $ Outcome : int 1 0 1 0 1 0 1 0 1 1 ...

## Classification tree model

diabetes\_model <- rpart(formula = diabetes$Outcome~. , data = diabetes, method = "class")

## display the decision tree

rpart.plot(x= diabetes\_model, yesno= 2, type = 0, extra= 0)



In the desicion tree plot we can see, that if Glucose is more than 128, if it is yes the tree branches towards age and bmi, and gives the outcome of the diabetes.

# Conclusion

In this Assignment I have taken two datasets from Kaggle one is New dataset and analysed the Lungcapacity using Simple linear Regression, Multiple linear regression and also i have used Logistic regression and a Non-Linear model Linear Discriminate Analysis in this dataset

In the Second Dataset, i have taken the diabetes data from kaggle and analysed it by decision Trees.

# References

1.Dataset “new” was taken from Kaggle: <https://www.kaggle.com/datasets/radhakrishna4/lung-capacity>

1. Dataset “Diabetes” is taken from kaggle <https://www.kaggle.com/datasets/akshaydattatraykhare/diabetes-dataset>
2. Analysis and intrepretation of the dataset is done by following the labs in the module C7081: <https://c7081-2022.github.io/website/>