hw2math4323

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2022-09-19

Question 1

Question 3 (a):

library("mlbench")

## Warning: package 'mlbench' was built under R version 4.1.3

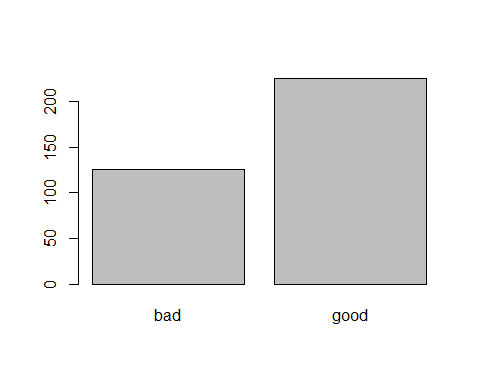
library("ggplot2")

## Warning: package 'ggplot2' was built under R version 4.1.3

data("Ionosphere")  
summary(Ionosphere)

## V1 V2 V3 V4 V5   
## 0: 38 0:351 Min. :-1.0000 Min. :-1.00000 Min. :-1.0000   
## 1:313 1st Qu.: 0.4721 1st Qu.:-0.06474 1st Qu.: 0.4127   
## Median : 0.8711 Median : 0.01631 Median : 0.8092   
## Mean : 0.6413 Mean : 0.04437 Mean : 0.6011   
## 3rd Qu.: 1.0000 3rd Qu.: 0.19418 3rd Qu.: 1.0000   
## Max. : 1.0000 Max. : 1.00000 Max. : 1.0000   
## V6 V7 V8 V9   
## Min. :-1.0000 Min. :-1.0000 Min. :-1.00000 Min. :-1.00000   
## 1st Qu.:-0.0248 1st Qu.: 0.2113 1st Qu.:-0.05484 1st Qu.: 0.08711   
## Median : 0.0228 Median : 0.7287 Median : 0.01471 Median : 0.68421   
## Mean : 0.1159 Mean : 0.5501 Mean : 0.11936 Mean : 0.51185   
## 3rd Qu.: 0.3347 3rd Qu.: 0.9692 3rd Qu.: 0.44567 3rd Qu.: 0.95324   
## Max. : 1.0000 Max. : 1.0000 Max. : 1.00000 Max. : 1.00000   
## V10 V11 V12 V13   
## Min. :-1.00000 Min. :-1.00000 Min. :-1.00000 Min. :-1.0000   
## 1st Qu.:-0.04807 1st Qu.: 0.02112 1st Qu.:-0.06527 1st Qu.: 0.0000   
## Median : 0.01829 Median : 0.66798 Median : 0.02825 Median : 0.6441   
## Mean : 0.18135 Mean : 0.47618 Mean : 0.15504 Mean : 0.4008   
## 3rd Qu.: 0.53419 3rd Qu.: 0.95790 3rd Qu.: 0.48237 3rd Qu.: 0.9555   
## Max. : 1.00000 Max. : 1.00000 Max. : 1.00000 Max. : 1.0000   
## V14 V15 V16 V17   
## Min. :-1.00000 Min. :-1.0000 Min. :-1.00000 Min. :-1.0000   
## 1st Qu.:-0.07372 1st Qu.: 0.0000 1st Qu.:-0.08170 1st Qu.: 0.0000   
## Median : 0.03027 Median : 0.6019 Median : 0.00000 Median : 0.5909   
## Mean : 0.09341 Mean : 0.3442 Mean : 0.07113 Mean : 0.3819   
## 3rd Qu.: 0.37486 3rd Qu.: 0.9193 3rd Qu.: 0.30897 3rd Qu.: 0.9357   
## Max. : 1.00000 Max. : 1.0000 Max. : 1.00000 Max. : 1.0000   
## V18 V19 V20 V21   
## Min. :-1.000000 Min. :-1.0000 Min. :-1.00000 Min. :-1.0000   
## 1st Qu.:-0.225690 1st Qu.: 0.0000 1st Qu.:-0.23467 1st Qu.: 0.0000   
## Median : 0.000000 Median : 0.5762 Median : 0.00000 Median : 0.4991   
## Mean :-0.003617 Mean : 0.3594 Mean :-0.02402 Mean : 0.3367   
## 3rd Qu.: 0.195285 3rd Qu.: 0.8993 3rd Qu.: 0.13437 3rd Qu.: 0.8949   
## Max. : 1.000000 Max. : 1.0000 Max. : 1.00000 Max. : 1.0000   
## V22 V23 V24 V25   
## Min. :-1.000000 Min. :-1.0000 Min. :-1.00000 Min. :-1.0000   
## 1st Qu.:-0.243870 1st Qu.: 0.0000 1st Qu.:-0.36689 1st Qu.: 0.0000   
## Median : 0.000000 Median : 0.5318 Median : 0.00000 Median : 0.5539   
## Mean : 0.008296 Mean : 0.3625 Mean :-0.05741 Mean : 0.3961   
## 3rd Qu.: 0.188760 3rd Qu.: 0.9112 3rd Qu.: 0.16463 3rd Qu.: 0.9052   
## Max. : 1.000000 Max. : 1.0000 Max. : 1.00000 Max. : 1.0000   
## V26 V27 V28 V29   
## Min. :-1.00000 Min. :-1.0000 Min. :-1.00000 Min. :-1.0000   
## 1st Qu.:-0.33239 1st Qu.: 0.2864 1st Qu.:-0.44316 1st Qu.: 0.0000   
## Median :-0.01505 Median : 0.7082 Median :-0.01769 Median : 0.4966   
## Mean :-0.07119 Mean : 0.5416 Mean :-0.06954 Mean : 0.3784   
## 3rd Qu.: 0.15676 3rd Qu.: 0.9999 3rd Qu.: 0.15354 3rd Qu.: 0.8835   
## Max. : 1.00000 Max. : 1.0000 Max. : 1.00000 Max. : 1.0000   
## V30 V31 V32 V33   
## Min. :-1.00000 Min. :-1.0000 Min. :-1.000000 Min. :-1.0000   
## 1st Qu.:-0.23689 1st Qu.: 0.0000 1st Qu.:-0.242595 1st Qu.: 0.0000   
## Median : 0.00000 Median : 0.4428 Median : 0.000000 Median : 0.4096   
## Mean :-0.02791 Mean : 0.3525 Mean :-0.003794 Mean : 0.3494   
## 3rd Qu.: 0.15407 3rd Qu.: 0.8576 3rd Qu.: 0.200120 3rd Qu.: 0.8138   
## Max. : 1.00000 Max. : 1.0000 Max. : 1.000000 Max. : 1.0000   
## V34 Class   
## Min. :-1.00000 bad :126   
## 1st Qu.:-0.16535 good:225   
## Median : 0.00000   
## Mean : 0.01448   
## 3rd Qu.: 0.17166   
## Max. : 1.00000

#par(mfrow=c(2,2))  
plot(Ionosphere$Class)



#plot(Ionosphere)  
#pairs(Ionosphere)

Question 3 (b):

newIonosphere <- Ionosphere[,-2]  
library(class)

## Warning: package 'class' was built under R version 4.1.3

y.class <- newIonosphere$Class  
q3.train <- newIonosphere[,-34]  
q3.test <- newIonosphere[,-34]  
  
q3.knn <- knn(train = q3.train, test = q3.test, cl=y.class, k=1)  
summary(q3.knn)

## bad good   
## 126 225

mean(q3.knn != y.class)

## [1] 0

Question 3 (c):

table(q3.knn, y.class)

## y.class  
## q3.knn bad good  
## bad 126 0  
## good 0 225

Question 3 (d):

n <- nrow(newIonosphere)  
set.seed(4323)  
seventypercent <- 0.7\*n  
split <- sample(1:n, seventypercent)  
x.train <- newIonosphere[split,-34]  
x.test <- newIonosphere[-split,-34]  
y.train <- newIonosphere$Class[split]  
y.test <- newIonosphere$Class[-split]  
  
set.seed(4323)  
knn.pred <- knn(train = x.train, test = x.test, cl = y.train, k=3)  
#mean(knn.pred != y.test)  
table(knn.pred, y.test)

## y.test  
## knn.pred bad good  
## bad 22 1  
## good 19 64

Question 3 (e):

set.seed(4323)  
knn.pred <- knn(train = x.train, test = x.test, cl = y.train, k=5)  
#mean(knn.pred != y.test)  
table(knn.pred, y.test)

## y.test  
## knn.pred bad good  
## bad 24 2  
## good 17 63

Question 3 (f):

set.seed(4323)  
knn.pred <- knn(train = x.train, test = x.test, cl = y.train, k=7)  
#mean(knn.pred != y.test)  
table(knn.pred, y.test)

## y.test  
## knn.pred bad good  
## bad 22 2  
## good 19 63

Question 3 (g):  
The best result is k=5

Question 4 (a):

library(ISLR)

## Warning: package 'ISLR' was built under R version 4.1.3

auto.med <- median(Auto$mpg)  
mpg01 <- ifelse(Auto$mpg > auto.med, yes = 1, no = 0)  
mpg01

## [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 1 1 1 1 0 0 0 0 0 1 1 1 0 0 0 0 0  
## [38] 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
## [75] 0 0 0 0 1 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0  
## [112] 0 0 1 0 0 1 1 0 0 0 1 0 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1  
## [149] 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 1 1 0 1 0 1 1 0 1 1 1 1 1 1 1  
## [186] 0 0 0 0 0 0 1 0 1 1 1 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 1 1 1 1 1 0 0 0  
## [223] 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 0 0 0 0 0  
## [260] 0 0 0 0 0 1 1 1 1 0 1 1 1 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1  
## [297] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  
## [334] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 1 1 1 1 1 1  
## [371] 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1