rpart prune

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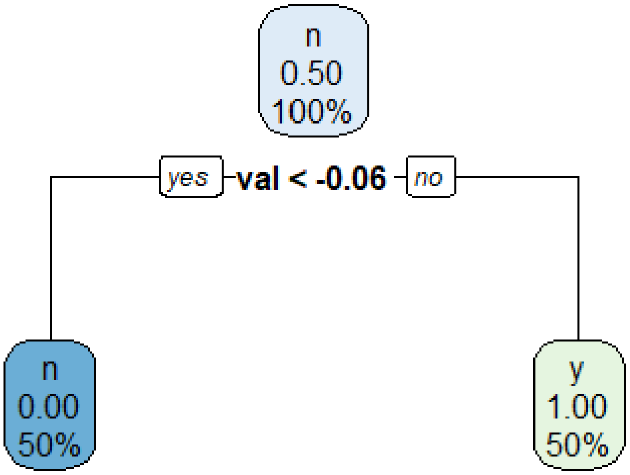
```r
# Loading the necessary packages for solving the question
library(rpart)
# Package to create the binary decision tree
library(rpart.plot)
```

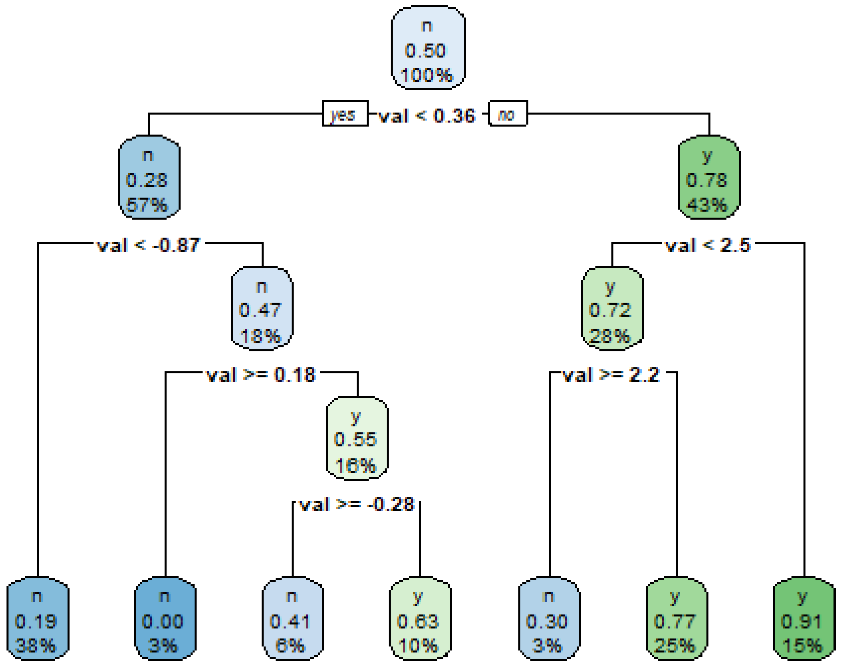
```
## Warning: package 'rpart.plot' was built under R version 4.2.3
```

```r
# Initialize a function for the gini index
gini <- function(m) {
  gini.index = 2 * m * (1 - m)
  return (gini.index)
}

# Initializing the function for the entropy value
entropy <- function(n) {
  entropy = (n * log(n) + (1 - n) * log(1 - n))
  return (entropy)
}

# set the seed value to 150
set.seed(150)

# Normal distribution for Mean as 5 and Standard Deviation as 2
x<-rnorm(n=150,mean=5,sd=2)

# Normal distribution for Mean as -5 and Standard Deviation as 2
y<-rnorm(n=150,mean=-5,sd=2)

# Make the dataframe based in the values from the Normal distribution
dt1 <- data.frame(val = x,label=rep("y",150))
dt2 <- data.frame(val = y,label=rep("n",150))

# Combine the two dataframes into one using rbind
dt <- rbind(dt1,dt2)

# Separating the label
dt$label <- as.factor(dt$label)

# Making use of rpart to place the text inside the tree
dtree <- rpart(label~val,dt,method="class")

# Now, plot the rpart of the decision tree
rpart.plot(dtree)
```



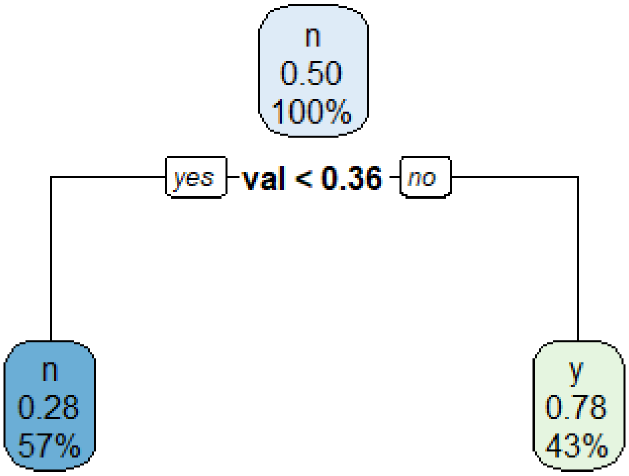
```
cat <- "The threshold value for the first split will be -0.06, as observed
from the above. Two leaf nodes and one root node make up the tree. Both
classes can be classified individually by a tree, demonstrating empirical
distribution."

# P is the probability of each node
p=c(.5, 0, 1)

# Calculating the gini vlues and entropy based on the above function
gini_values=sapply(p, gini)
gini_values

## [1] 0.5 0.0 0.0

entropy_values=sapply(p, entropy)
entropy_values

## [1] -0.6931472        NaN        NaN

# The gini values for above tree -  0.5, 0.0, 0.0
# The entropy values for above tree - 0.6931472, NaN, NaN

# set the seed value to 150
set.seed(150)

# Normal distribution for Mean as 1 and Standard Deviation as 2
x1<-rnorm(n=150,mean=1,sd=2)
```

```r
# Normal distribution for Mean as -1 and Standard Deviation as 2
y1<-rnorm(n=150,mean=-1,sd=2)

# Make the dataframe based in the values from the Normal distribution
dt3 <- data.frame(val = x1,label=rep("y",150))
# Make the dataframe based in the values from the Normal distribution
dt4 <- data.frame(val = y1,label=rep("n",150))

# Combining the two dataframes into one using rbind
data <- rbind(dt3,dt4)
data$label <- as.factor(data$label)

# Making use of rpart to place the text inside the tree
dtree1 <- rpart(label~val,data,method="class")
# Now, plot the rpart of the decision tree
rpart.plot(dtree1)
```



```r
cat <- "The threshold value for the first split, based on the tree above, is
0.36.
The tree comprises 13 nodes, one of which is the root node.
There are a total of 7 leaf nodes on the tree.
Large tree size indicates the node's presence of more distinct labels, which
led to the tree's size.
Consequently, this tree has higher label overlap in the nodes."

# P1 is the probability of each node
p1=c(.5,0.22,0.72,0.28,0.53,0.45,0.09,0.23,0.70,0.37,0.59,1.0,0.81)
```

```
# Used the probability to get the gini and entropy
gini_values1=sapply(p1, gini)
gini_values1

##  [1] 0.5000 0.3432 0.4032 0.4032 0.4982 0.4950 0.1638 0.3542 0.4200 0.4662
## [11] 0.4838 0.0000 0.3078

entropy_values1=sapply(p1, entropy)
entropy_values1

##  [1] -0.6931472 -0.5269080 -0.5929533 -0.5929533 -0.6913461 -0.6881388
##  [7] -0.3025378 -0.5392763 -0.6108643 -0.6589557 -0.6768585        NaN
## [13] -0.4862230

newtree <- prune.rpart(dtree1,cp=0.1)
rpart.plot(newtree)
```



```
cat <- " The threshold value for the first split will be 0.36. The tree has
one root node and 2 leaf nodes."
# P2 is the probability of each node
p2=c(.5,0.22,0.72)
gini_values2=sapply(p2, gini)
gini_values2

## [1] 0.5000 0.3432 0.4032

entropy_values2=sapply(p2, entropy)
entropy_values2
```

```
## [1] -0.6931472 -0.5269080 -0.5929533

# The gini values for above tree =  0.5000, 0.3432, 0.4032
# The entropy values for above tree =  -0.6931472, -0.5269080, -0.5929533
```