Weather Prediction

2022-12-12

```
#Read the data
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(plyr)
```

```
## Warning: package 'plyr' was built under R version 4.2.2

## ------------------------------------------------------------------------------

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## ------------------------------------------------------------------------------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
```

```
data<-read.csv("weather.csv")
head(data)
```

```
##   MinTemp MaxTemp Rainfall Evaporation Sunshine WindGustDir WindGustSpeed
## 1     8.0    24.3      0.0         3.4      6.3          NW            30
## 2    14.0    26.9      3.6         4.4      9.7         ENE            39
```

```
## 3    13.7    23.4      3.6         5.8      3.3          NW            85
## 4    13.3    15.5     39.8         7.2      9.1          NW            54
## 5     7.6    16.1      2.8         5.6     10.6         SSE            50
## 6     6.2    16.9      0.0         5.8      8.2          SE            44
##   WindDir9am WindDir3pm WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm
## 1         SW         NW            6           20          68          29
## 2          E          W            4           17          80          36
## 3          N        NNE            6            6          82          69
## 4        WNW          W           30           24          62          56
## 5        SSE        ESE           20           28          68          49
## 6         SE          E           20           24          70          57
##   Pressure9am Pressure3pm Cloud9am Cloud3pm Temp9am Temp3pm RainToday
## 1      1019.7      1015.0        7        7    14.4    23.6        No
## 2      1012.4      1008.4        5        3    17.5    25.7       Yes
## 3      1009.5      1007.2        8        7    15.4    20.2       Yes
## 4      1005.5      1007.0        2        7    13.5    14.1       Yes
## 5      1018.3      1018.5        7        7    11.1    15.4       Yes
## 6      1023.8      1021.7        7        5    10.9    14.8        No
##   RainTomorrow
## 1          Yes
## 2          Yes
## 3          Yes
## 4          Yes
## 5           No
## 6           No
```

```
summary(data)
```

```
##     MinTemp          MaxTemp         Rainfall       Evaporation
##  Min.   :-5.300   Min.   : 7.60   Min.   : 0.000   Min.   : 0.200
##  1st Qu.: 2.300   1st Qu.:15.03   1st Qu.: 0.000   1st Qu.: 2.200
##  Median : 7.450   Median :19.65   Median : 0.000   Median : 4.200
##  Mean   : 7.266   Mean   :20.55   Mean   : 1.428   Mean   : 4.522
##  3rd Qu.:12.500   3rd Qu.:25.50   3rd Qu.: 0.200   3rd Qu.: 6.400
##  Max.   :20.900   Max.   :35.80   Max.   :39.800   Max.   :13.800
##
##     Sunshine      WindGustDir        WindGustSpeed    WindDir9am
##  Min.   : 0.000   Length:366         Min.   :13.00   Length:366
##  1st Qu.: 5.950   Class :character   1st Qu.:31.00   Class :character
##  Median : 8.600   Mode  :character   Median :39.00   Mode  :character
##  Mean   : 7.909                      Mean   :39.84
##  3rd Qu.:10.500                      3rd Qu.:46.00
##  Max.   :13.600                      Max.   :98.00
##  NA's   :3                           NA's   :2
##   WindDir3pm         WindSpeed9am     WindSpeed3pm    Humidity9am
##  Length:366         Min.   : 0.000   Min.   : 0.00   Min.   :36.00
##  Class :character   1st Qu.: 6.000   1st Qu.:11.00   1st Qu.:64.00
##  Mode  :character   Median : 7.000   Median :17.00   Median :72.00
##                     Mean   : 9.652   Mean   :17.99   Mean   :72.04
##                     3rd Qu.:13.000   3rd Qu.:24.00   3rd Qu.:81.00
##                     Max.   :41.000   Max.   :52.00   Max.   :99.00
##                     NA's   :7
##   Humidity3pm     Pressure9am      Pressure3pm        Cloud9am
##  Min.   :13.00   Min.   : 996.5   Min.   : 996.8   Min.   :0.000
```

```
##  1st Qu.:32.25   1st Qu.:1015.4   1st Qu.:1012.8   1st Qu.:1.000
##  Median :43.00   Median :1020.1   Median :1017.4   Median :3.500
##  Mean   :44.52   Mean   :1019.7   Mean   :1016.8   Mean   :3.891
##  3rd Qu.:55.00   3rd Qu.:1024.5   3rd Qu.:1021.5   3rd Qu.:7.000
##  Max.   :96.00   Max.   :1035.7   Max.   :1033.2   Max.   :8.000
##
##     Cloud3pm        Temp9am          Temp3pm       RainToday
##  Min.   :0.000   Min.   : 0.100   Min.   : 5.10   Length:366
##  1st Qu.:1.000   1st Qu.: 7.625   1st Qu.:14.15   Class :character
##  Median :4.000   Median :12.550   Median :18.55   Mode  :character
##  Mean   :4.025   Mean   :12.358   Mean   :19.23
##  3rd Qu.:7.000   3rd Qu.:17.000   3rd Qu.:24.00
##  Max.   :8.000   Max.   :24.700   Max.   :34.50
##
##  RainTomorrow
##  Length:366
##  Class :character
##  Mode  :character
##
##
##
##
```

Changing boolean values

```
#data$RainToday <- revalue(data$RainToday, c("Yes"=1))
#data$RainTomorrow <- revalue(data$RainTomorrow, c("Yes"=1))
#data$RainToday <- revalue(data$RainToday, c("No"=0))
#data$RainTomorrow <- revalue(data$RainTomorrow, c("No"=0))
data$RainToday=as.factor(data$RainToday)
data$RainTomorrow=as.factor(data$RainTomorrow)
head(data)
```

```
##   MinTemp MaxTemp Rainfall Evaporation Sunshine WindGustDir WindGustSpeed
## 1     8.0    24.3      0.0         3.4      6.3          NW            30
## 2    14.0    26.9      3.6         4.4      9.7         ENE            39
## 3    13.7    23.4      3.6         5.8      3.3          NW            85
## 4    13.3    15.5     39.8         7.2      9.1          NW            54
## 5     7.6    16.1      2.8         5.6     10.6         SSE            50
## 6     6.2    16.9      0.0         5.8      8.2          SE            44
##   WindDir9am WindDir3pm WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm
## 1         SW         NW            6           20          68          29
## 2          E          W            4           17          80          36
## 3          N        NNE            6            6          82          69
## 4        WNW          W           30           24          62          56
## 5        SSE        ESE           20           28          68          49
## 6         SE          E           20           24          70          57
##   Pressure9am Pressure3pm Cloud9am Cloud3pm Temp9am Temp3pm RainToday
## 1      1019.7      1015.0        7        7    14.4    23.6        No
## 2      1012.4      1008.4        5        3    17.5    25.7       Yes
## 3      1009.5      1007.2        8        7    15.4    20.2       Yes
## 4      1005.5      1007.0        2        7    13.5    14.1       Yes
## 5      1018.3      1018.5        7        7    11.1    15.4       Yes
```

```
## 6      1023.8      1021.7        7        5    10.9    14.8        No
##   RainTomorrow
## 1          Yes
## 2          Yes
## 3          Yes
## 4          Yes
## 5           No
## 6           No
```

Check for any missing values and remove them

```
sum(is.na(data))
```

```
## [1] 47
```

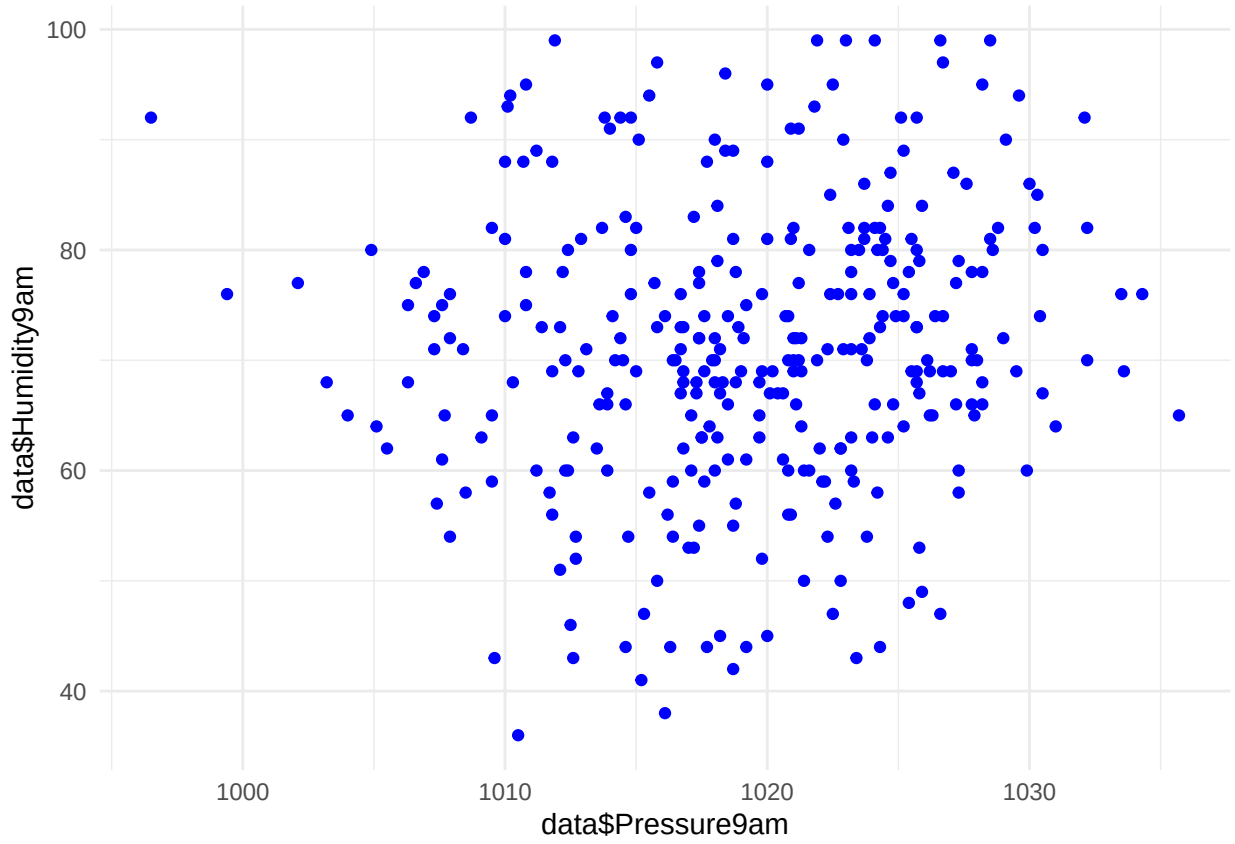
```
data=na.omit(data)
head(data)
```

```
##   MinTemp MaxTemp Rainfall Evaporation Sunshine WindGustDir WindGustSpeed
## 1     8.0    24.3      0.0         3.4      6.3          NW            30
## 2    14.0    26.9      3.6         4.4      9.7         ENE            39
## 3    13.7    23.4      3.6         5.8      3.3          NW            85
## 4    13.3    15.5     39.8         7.2      9.1          NW            54
## 5     7.6    16.1      2.8         5.6     10.6         SSE            50
## 6     6.2    16.9      0.0         5.8      8.2          SE            44
##   WindDir9am WindDir3pm WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm
## 1         SW         NW            6           20          68          29
## 2          E          W            4           17          80          36
## 3          N        NNE            6            6          82          69
## 4        WNW          W           30           24          62          56
## 5        SSE        ESE           20           28          68          49
## 6         SE          E           20           24          70          57
##   Pressure9am Pressure3pm Cloud9am Cloud3pm Temp9am Temp3pm RainToday
## 1      1019.7      1015.0        7        7    14.4    23.6        No
## 2      1012.4      1008.4        5        3    17.5    25.7       Yes
## 3      1009.5      1007.2        8        7    15.4    20.2       Yes
## 4      1005.5      1007.0        2        7    13.5    14.1       Yes
## 5      1018.3      1018.5        7        7    11.1    15.4       Yes
## 6      1023.8      1021.7        7        5    10.9    14.8        No
##   RainTomorrow
## 1          Yes
## 2          Yes
## 3          Yes
## 4          Yes
## 5           No
## 6           No
```

As the wind pressure increases the humidity also shows a rise

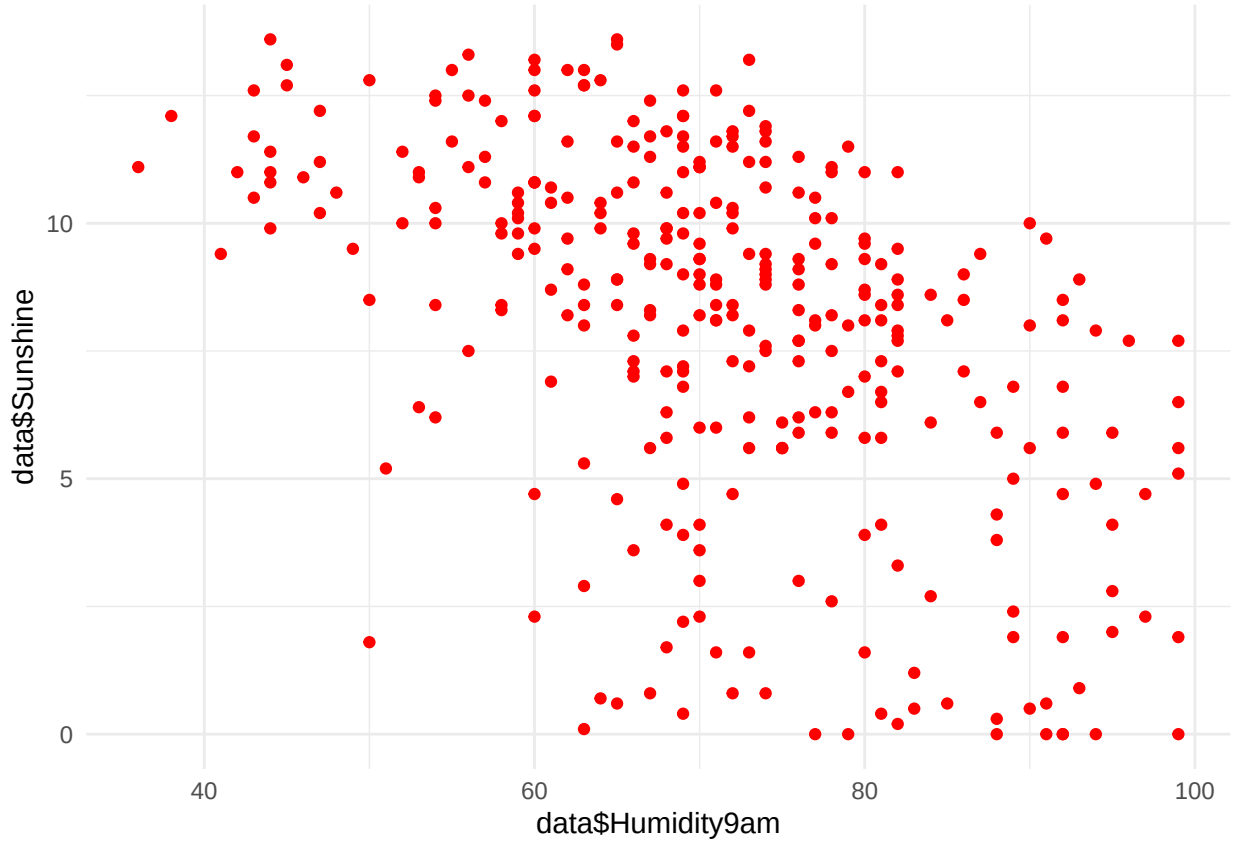
```
library(ggplot2)

ggplot(data) +
```

```
  aes(x = data$Pressure9am,y=data$Humidity9am) +
  geom_point(colour = "blue") +
  theme_minimal()
```

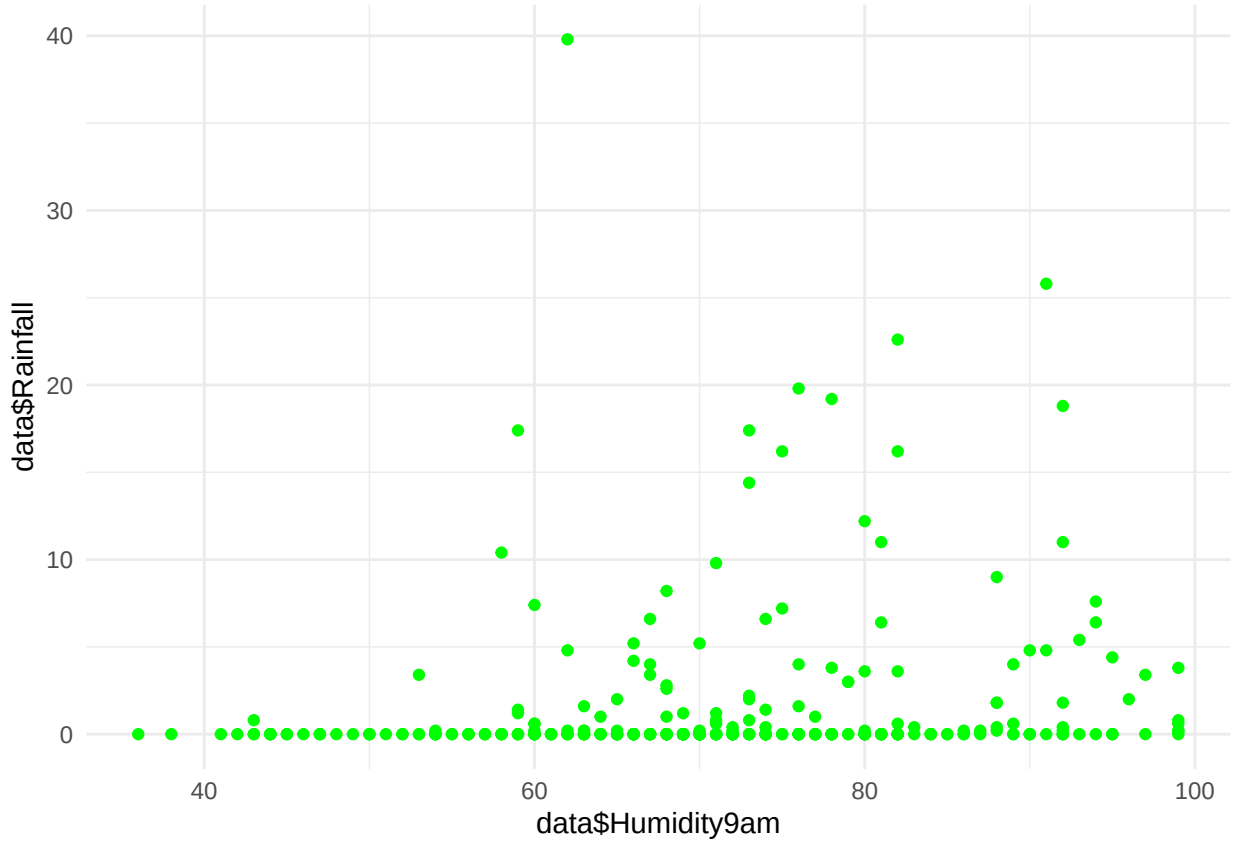


The increase in humidity percentage affects the sunshine amount positively.

```
ggplot(data) +
  aes(x = data$Humidity9am,y=data$Sunshine) +
  geom_point(colour = "red") +
  theme_minimal()
```




```
ggplot(data) +
  aes(x = data$Humidity9am,y=data$Rainfall) +
  geom_point(colour = "green") +
  theme_minimal()
```



SPLITTING THE DATA INTO TRAIN AND TEST SETS

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.2.2
```

```
## Loading required package: lattice
```

```
index <- sample(c(TRUE, FALSE), nrow(data), replace=TRUE, prob=c(0.80,0.20))
trainData<-data[index,]
testData<-data[!index,]
dim(trainData)
```

```
## [1] 258  21
```

```
dim(testData)
```

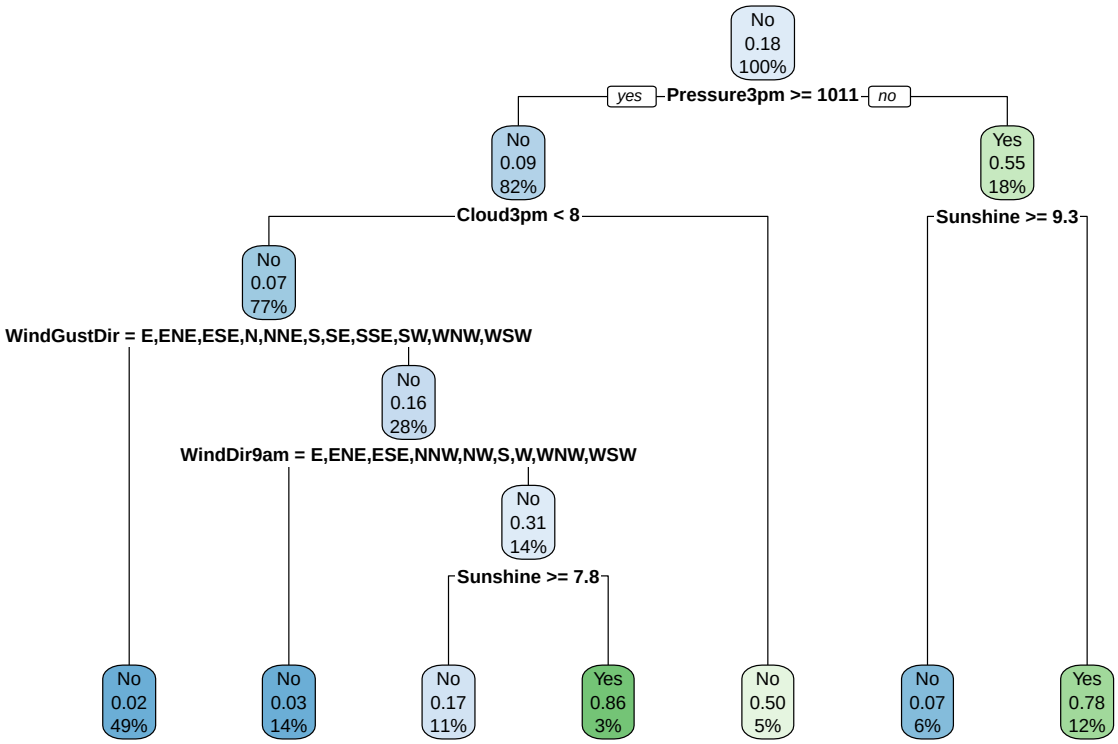
```
## [1] 70 21
```

BUILDING THE DECISION TREE MODEL

```
library(rpart)
library(rpart.plot)
```

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

```
model=rpart(RainTomorrow~.,trainData)
rpart.plot(model)
```




```
Prediction <- predict(model, testData, type= "class")
confusionMatrix(Prediction, testData$RainTomorrow, positive= "Yes")
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction No Yes
##        No  50   6
##        Yes  6   8
##
##                Accuracy : 0.8286
##                  95% CI : (0.7197, 0.9082)
##     No Information Rate : 0.8
##     P-Value [Acc > NIR] : 0.336
##
##                   Kappa : 0.4643
##
##  Mcnemar's Test P-Value : 1.000
##
##             Sensitivity : 0.5714
```

```
##             Specificity : 0.8929
##          Pos Pred Value : 0.5714
##          Neg Pred Value : 0.8929
##              Prevalence : 0.2000
##          Detection Rate : 0.1143
##    Detection Prevalence : 0.2000
##       Balanced Accuracy : 0.7321
##
##        'Positive' Class : Yes
##
```

The Accuracy of the model is 86.57%

```
summary(model)
```

```
## Call:
## rpart(formula = RainTomorrow ~ ., data = trainData)
##   n= 258
##
##           CP nsplit rel error    xerror      xstd
## 1 0.19565217      0 1.0000000 1.0000000 0.1336531
## 2 0.02717391      2 0.6086957 0.6304348 0.1102933
## 3 0.01000000      6 0.5000000 0.9565217 0.1313305
##
## Variable importance
##      Sunshine   Pressure3pm   Pressure9am      Cloud3pm   Humidity3pm
##            17            16            12            12            10
##       Temp3pm       MaxTemp   Humidity9am    WindDir3pm    WindDir9am
##             5             5             4             4             3
##      Cloud9am      Rainfall   WindGustDir WindGustSpeed       Temp9am
##             3             2             2             2             2
##       MinTemp
##             1
##
## Node number 1: 258 observations,    complexity param=0.1956522
##   predicted class=No   expected loss=0.1782946  P(node) =1
##     class counts:   212    46
##    probabilities: 0.822 0.178
##   left son=2 (211 obs) right son=3 (47 obs)
##   Primary splits:
##       Pressure3pm   < 1010.65 to the right, improve=16.154330, (0 missing)
##       Sunshine      < 6.45    to the right, improve=11.077490, (0 missing)
##       Cloud3pm      < 6.5     to the left,  improve=11.022000, (0 missing)
##       Pressure9am   < 1013    to the right, improve= 9.843438, (0 missing)
##       WindGustSpeed < 66      to the left,  improve= 8.505564, (0 missing)
##   Surrogate splits:
##       Pressure9am   < 1013.3  to the right, agree=0.953, adj=0.745, (0 split)
##       Temp9am       < 22.75   to the left,  agree=0.837, adj=0.106, (0 split)
##       WindGustSpeed < 73      to the left,  agree=0.833, adj=0.085, (0 split)
##       Humidity3pm   < 70.5    to the left,  agree=0.829, adj=0.064, (0 split)
##       MinTemp       < 18.95   to the left,  agree=0.826, adj=0.043, (0 split)
##
## Node number 2: 211 observations,    complexity param=0.02717391
```

```
##   predicted class=No   expected loss=0.09478673  P(node) =0.8178295
##     class counts:   191    20
##    probabilities: 0.905 0.095
##   left son=4 (199 obs) right son=5 (12 obs)
##   Primary splits:
##       Cloud3pm    < 7.5     to the left,  improve=4.178380, (0 missing)
##       Sunshine    < 2.1     to the right, improve=3.404271, (0 missing)
##       MinTemp     < 16.6    to the left,  improve=3.289763, (0 missing)
##       WindGustDir splits as  LLRLRLRRLLRRLRLL, improve=2.760603, (0 missing)
##       Pressure3pm < 1016.05 to the right, improve=2.576178, (0 missing)
##   Surrogate splits:
##       Sunshine    < 0.3     to the right, agree=0.962, adj=0.333, (0 split)
##       Humidity3pm < 71.5    to the left,  agree=0.957, adj=0.250, (0 split)
##       Rainfall    < 20      to the left,  agree=0.953, adj=0.167, (0 split)
##
## Node number 3: 47 observations,    complexity param=0.1956522
##   predicted class=Yes  expected loss=0.4468085  P(node) =0.1821705
##     class counts:    21    26
##    probabilities: 0.447 0.553
##   left son=6 (15 obs) right son=7 (32 obs)
##   Primary splits:
##       Sunshine    < 9.3     to the right, improve=10.429880, (0 missing)
##       WindGustDir splits as  RLRRR-RRR-RRRRLL, improve= 6.812990, (0 missing)
##       Humidity3pm < 42      to the left,  improve= 6.506770, (0 missing)
##       Temp9am     < 18.35   to the right, improve= 5.383062, (0 missing)
##       WindDir9am  splits as  LRLR-LLLRRRR-LLL, improve= 5.324268, (0 missing)
##   Surrogate splits:
##       Humidity3pm < 38.5    to the left,  agree=0.851, adj=0.533, (0 split)
##       MaxTemp     < 30.05   to the right, agree=0.830, adj=0.467, (0 split)
##       Cloud3pm    < 1.5     to the left,  agree=0.830, adj=0.467, (0 split)
##       Temp3pm     < 28.4    to the right, agree=0.830, adj=0.467, (0 split)
##       Humidity9am < 60.5    to the left,  agree=0.809, adj=0.400, (0 split)
##
## Node number 4: 199 observations,    complexity param=0.02717391
##   predicted class=No   expected loss=0.07035176  P(node) =0.7713178
##     class counts:   185    14
##    probabilities: 0.930 0.070
##   left son=8 (126 obs) right son=9 (73 obs)
##   Primary splits:
##       WindGustDir splits as  LLLLRLRRLLLRLRLL, improve=2.038848, (0 missing)
##       Temp9am     < 21.6    to the left,  improve=1.861996, (0 missing)
##       Pressure3pm < 1016.05 to the right, improve=1.675859, (0 missing)
##       WindDir9am  splits as  LLLRRRLLLRRRRLLL, improve=1.607276, (0 missing)
##       MinTemp     < 16.4    to the left,  improve=1.547166, (0 missing)
##   Surrogate splits:
##       WindDir3pm  splits as  LLLLLLLRLLLLLLLL, agree=0.724, adj=0.247, (0 split)
##       WindDir9am  splits as  LLLRRRLLLLLLLRRL, agree=0.698, adj=0.178, (0 split)
##       Pressure3pm < 1013.95 to the right, agree=0.683, adj=0.137, (0 split)
##       Humidity9am < 44.5    to the right, agree=0.668, adj=0.096, (0 split)
##       Humidity3pm < 22.5    to the right, agree=0.658, adj=0.068, (0 split)
##
## Node number 5: 12 observations
##   predicted class=No   expected loss=0.5  P(node) =0.04651163
##     class counts:     6     6
```

```
##    probabilities: 0.500 0.500
##
## Node number 6: 15 observations
##   predicted class=No   expected loss=0.06666667  P(node) =0.05813953
##     class counts:    14     1
##    probabilities: 0.933 0.067
##
## Node number 7: 32 observations
##   predicted class=Yes  expected loss=0.21875  P(node) =0.124031
##     class counts:     7    25
##    probabilities: 0.219 0.781
##
## Node number 8: 126 observations
##   predicted class=No   expected loss=0.01587302  P(node) =0.4883721
##     class counts:   124     2
##    probabilities: 0.984 0.016
##
## Node number 9: 73 observations,    complexity param=0.02717391
##   predicted class=No   expected loss=0.1643836  P(node) =0.2829457
##     class counts:    61    12
##    probabilities: 0.836 0.164
##   left son=18 (37 obs) right son=19 (36 obs)
##   Primary splits:
##       WindDir9am    splits as  LLLRRRLLLRRRRLLL, improve=2.831071, (0 missing)
##       Cloud3pm      < 4.5     to the left,  improve=1.841461, (0 missing)
##       Sunshine      < 10.9    to the right, improve=1.701853, (0 missing)
##       MinTemp       < 14.55   to the left,  improve=1.080769, (0 missing)
##       WindGustSpeed < 54.5    to the left,  improve=1.080769, (0 missing)
##   Surrogate splits:
##       WindDir3pm    splits as  RRRLRRRRRLR--LRL, agree=0.658, adj=0.306, (0 split)
##       Pressure9am   < 1018.3  to the left,  agree=0.644, adj=0.278, (0 split)
##       Temp3pm       < 15.7    to the left,  agree=0.644, adj=0.278, (0 split)
##       MaxTemp       < 16.3    to the left,  agree=0.630, adj=0.250, (0 split)
##       WindGustSpeed < 32      to the right, agree=0.616, adj=0.222, (0 split)
##
## Node number 18: 37 observations
##   predicted class=No   expected loss=0.02702703  P(node) =0.1434109
##     class counts:    36     1
##    probabilities: 0.973 0.027
##
## Node number 19: 36 observations,    complexity param=0.02717391
##   predicted class=No   expected loss=0.3055556  P(node) =0.1395349
##     class counts:    25    11
##    probabilities: 0.694 0.306
##   left son=38 (29 obs) right son=39 (7 obs)
##   Primary splits:
##       Sunshine    < 7.8     to the right, improve=5.287630, (0 missing)
##       Cloud3pm    < 4.5     to the left,  improve=3.906540, (0 missing)
##       Humidity3pm < 28.5    to the left,  improve=2.585470, (0 missing)
##       Cloud9am    < 2.5     to the left,  improve=2.207544, (0 missing)
##       Pressure3pm < 1016.65 to the right, improve=1.754558, (0 missing)
##   Surrogate splits:
##       Humidity3pm < 48.5    to the left,  agree=0.917, adj=0.571, (0 split)
##       Cloud9am    < 6.5     to the left,  agree=0.917, adj=0.571, (0 split)
```

```
##       Cloud3pm    < 6.5     to the left,  agree=0.917, adj=0.571, (0 split)
##       WindDir3pm  splits as  LLRLLLLLR-R--LL-, agree=0.889, adj=0.429, (0 split)
##       Rainfall    < 0.3     to the left,  agree=0.861, adj=0.286, (0 split)
##
## Node number 38: 29 observations
##   predicted class=No   expected loss=0.1724138  P(node) =0.1124031
##     class counts:    24     5
##    probabilities: 0.828 0.172
##
## Node number 39: 7 observations
##   predicted class=Yes  expected loss=0.1428571  P(node) =0.02713178
##     class counts:     1     6
##    probabilities: 0.143 0.857
```