IST-707-Final-Project-Code.R

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2020-03-21

```
# https://s3-us-west-2.amazonaws.com/syr-mac/prod/IST+565+Data+Mining/PDFs/Assignments/Project-instructions-updated-11-27-2017.pdf
# https://archive.ics.uci.edu/ml/datasets/Forest+Fires
# https://towardsdatascience.com/beginners-guide-to-k-nearest-neighbors-in-r-from-zero-to-hero-d92cd4074bdb

# install.packages("ggvis")
# install.packages("plotrix")
# install.packages("ISLR")
# install.packages("ggplot2") # install.packages("plyr")
# install.packages("dplyr") # install.packages("class")# Load libraries
# install.packages("tidyverse")
# install.packages("cluster")
# install.packages("factoextra")
# install.packages("randomForest")
# install.packages("pROC")
# install.packages("FSelector")
# install.packages("GGally")
# install.packages("taRifx")
# install.packages("klar")
# install.packages("purrr")
library(purrr)
library(GGally)
```

```
## Loading required package: ggplot2
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
library(taRifx)
```

```
##
## Attaching package: 'taRifx'
```

```
## The following object is masked from 'package:purrr':
##
##     rep_along
```

```
library(pROC)
```

```
## Type 'citation("pROC")' for a citation.
```

```
##
## Attaching package: 'pROC'
```

```
## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
library(FSelector)
library(randomForest)
```

```
## randomForest 4.6-14
```

```
## Type rfNews() to see new features/changes/bug fixes.
```

```
##
## Attaching package: 'randomForest'
```

```
## The following object is masked from 'package:ggplot2':
##
##     margin
```

```
library(readr)
library(ggplot2)
library(ISLR)
library(reshape2)
library(plyr)
```

```
##
## Attaching package: 'plyr'
```

```
## The following object is masked from 'package:purrr':
##
##     compact
```

```
library(dplyr)
```

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

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

```
## The following object is masked from 'package:randomForest':
##
##     combine
```

```
## The following objects are masked from 'package:taRifx':
##
##     between, distinct, first, last
```

```
## The following object is masked from 'package:GGally':
##
##     nasa
```

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

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

```
library(class)
library(ggvis)
```

```
##
## Attaching package: 'ggvis'
```

```
## The following object is masked from 'package:ggplot2':
##
##     resolution
```

```
library(readxl)
library(plotrix)
library(cluster)
library(factoextra)
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WB
a
```

```
# library(tidyverse)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

```
## The following object is masked from 'package:randomForest':
##
##     combine
```

```
library(cluster)
library(reshape2)
library(tidyr)
```

```
##
## Attaching package: 'tidyr'
```

```
## The following object is masked from 'package:reshape2':
##
##     smiths
```

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

```
##
## Attaching package: 'MASS'
```

```
## The following object is masked from 'package:dplyr':
##
##     select
```

```
library(caTools)
library(sqldf)
```

```
## Loading required package: gsubfn
```

```
## Loading required package: proto
```

```
## Loading required package: RSQLite
```

```
library(corrplot)
```

```
## corrplot 0.84 loaded
```

```
library(corrgram)
```

```
## Registered S3 method overwritten by 'seriation':
##   method         from
##   reorder.hclust gclus
```

```
##
## Attaching package: 'corrgram'
```

```
## The following object is masked from 'package:plyr':
##
##     baseball
```

```
library(e1071)
library(caret)
```

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

```
##
## Attaching package: 'lattice'
```

```
## The following object is masked from 'package:corrgram':
##
##     panel.fill
```

```
##
## Attaching package: 'caret'
```

```
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(pROC)
library(CORElearn)
library(RWeka)
```

```
##
## Attaching package: 'RWeka'
```

```
## The following object is masked from 'package:caTools':
##
##     LogitBoost
```

```
library(FSelector)

# Load files
forestfires <- read_csv("forestfires.csv")
```

```
## Parsed with column specification:
## cols(
##   month = col_character(),
##   day = col_character(),
##   X = col_double(),
##   Y = col_double(),
##   FFMC = col_double(),
##   DMC = col_double(),
##   DC = col_double(),
##   ISI = col_double(),
##   temp = col_double(),
##   RH = col_double(),
##   wind = col_double(),
##   rain = col_double(),
##   area = col_double()
## )
```

```
forestfiresEX <-read_excel("ForestFiresWith.xlsx")
forestfires_na_factor <- read_csv("forestfires.csv")
```

```
## Parsed with column specification:
## cols(
##   month = col_character(),
##   day = col_character(),
##   X = col_double(),
##   Y = col_double(),
##   FFMC = col_double(),
##   DMC = col_double(),
##   DC = col_double(),
##   ISI = col_double(),
##   temp = col_double(),
##   RH = col_double(),
##   wind = col_double(),
##   rain = col_double(),
##   area = col_double()
## )
```

```
# find mean for foest fires
mean(forestfires$area)
```

```
## [1] 12.84729
```

```
# Feature generation
## IF the area burned is greater than .1 , equals a significant fire
forestfires$fire_yes_no <- ifelse(forestfires$area>0.1,1,0)

# Create a new data frame for newly made significant fire data
#forestfiresmm <- forestfires %>% select(X,Y,month,day,FFMC,DMC,DC,ISI,temp,RH,wind,rai
n,area,fire_yes_no) %>% filter(forestfires$fire_yes_no == "1")
forestfiresmm <- forestfires %>% filter(forestfires$fire_yes_no == "1")
forestfiresmm
```

```
## # A tibble: 269 x 14
##    month day       X     Y  FFMC   DMC    DC   ISI  temp    RH  wind  rain
##    <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1 jul   tue       9     9  85.8  48.3 313.    3.9  18      42   2.7     0
##  2 sep   tue       1     4  91   130.  693.    7    21.7    38   2.2     0
##  3 sep   mon       2     5  90.9 126.  686.    7    21.9    39   1.8     0
##  4 aug   wed       1     2  95.5  99.9 513.   13.2  23.3    31   4.5     0
##  5 aug   fri       8     6  90.1 108   530.   12.5  21.2    51   8.9     0
##  6 jul   sat       1     2  90    51.3 296.    8.7  16.6    53   5.4     0
##  7 aug   wed       2     5  95.5  99.9 513.   13.2  23.8    32   5.4     0
##  8 aug   thu       6     5  95.2 132.  579.   10.4  27.4    22   4       0
##  9 mar   mon       5     4  90.1  39.7  86.6   6.2  13.2    40   5.4     0
## 10 sep   tue       8     3  84.4  73.4 672.    3.2  24.2    28   3.6     0
## # … with 259 more rows, and 2 more variables: area <dbl>,
## #   fire_yes_no <dbl>
```

```
# Scale OG data frame
forestfires.scaled <- forestfires
forestfires.scaled$FFMC <- scale(forestfires$FFMC)
forestfires.scaled$DMC <- scale(forestfires$DMC)
forestfires.scaled$DC <- scale(forestfires$DC)
forestfires.scaled$ISI <- scale(forestfires$ISI)
forestfires.scaled$temp <- scale(forestfires$temp)
forestfires.scaled$RH <- scale(forestfires$RH)
forestfires.scaled$wind <- scale(forestfires$wind)
forestfires.scaled$rain <- scale(forestfires$rain)
forestfires.scaled$area <- scale(forestfires$area)

# Scale significant fire data frame
forestfiresmm.scaled <- forestfiresmm
forestfiresmm.scaled$FFMC <- scale(forestfiresmm.scaled$FFMC)
forestfiresmm.scaled$DMC <- scale(forestfiresmm.scaled$DMC)
forestfiresmm.scaled$DC <- scale(forestfiresmm.scaled$DC)
forestfiresmm.scaled$ISI <- scale(forestfiresmm.scaled$ISI)
forestfiresmm.scaled$temp <- scale(forestfiresmm.scaled$temp)
forestfiresmm.scaled$RH <- scale(forestfiresmm.scaled$RH)
forestfiresmm.scaled$wind <- scale(forestfiresmm.scaled$wind)
forestfiresmm.scaled$rain <- scale(forestfiresmm.scaled$rain)
forestfiresmm.scaled$area <- scale(forestfiresmm.scaled$area)

# View it
View(forestfires)
# Str
str(forestfires)
```

```
## Classes 'spec_tbl_df', 'tbl_df', 'tbl' and 'data.frame': 517 obs. of  14 variables:
##  $ month      : chr  "mar" "oct" "oct" "mar" ...
##  $ day        : chr  "fri" "tue" "sat" "fri" ...
##  $ X          : num  7 7 7 8 8 8 8 8 8 7 ...
##  $ Y          : num  5 4 4 6 6 6 6 6 6 5 ...
##  $ FFMC       : num  86.2 90.6 90.6 91.7 89.3 92.3 92.3 91.5 91 92.5 ...
##  $ DMC        : num  26.2 35.4 43.7 33.3 51.3 ...
##  $ DC         : num  94.3 669.1 686.9 77.5 102.2 ...
##  $ ISI        : num  5.1 6.7 6.7 9 9.6 14.7 8.5 10.7 7 7.1 ...
##  $ temp       : num  8.2 18 14.6 8.3 11.4 22.2 24.1 8 13.1 22.8 ...
##  $ RH         : num  51 33 33 97 99 29 27 86 63 40 ...
##  $ wind       : num  6.7 0.9 1.3 4 1.8 5.4 3.1 2.2 5.4 4 ...
##  $ rain       : num  0 0 0 0.2 0 0 0 0 0 0 ...
##  $ area       : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ fire_yes_no: num  0 0 0 0 0 0 0 0 0 0 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   month = col_character(),
##   ..   day = col_character(),
##   ..   X = col_double(),
##   ..   Y = col_double(),
##   ..   FFMC = col_double(),
##   ..   DMC = col_double(),
##   ..   DC = col_double(),
##   ..   ISI = col_double(),
##   ..   temp = col_double(),
##   ..   RH = col_double(),
##   ..   wind = col_double(),
##   ..   rain = col_double(),
##   ..   area = col_double()
##   .. )
```

```
# Descripitive Summary
summary(forestfires)
```

```
##     month               day                 X               Y        
##  Length:517         Length:517         Min.   :1.000   Min.   :2.0  
##  Class :character   Class :character   1st Qu.:3.000   1st Qu.:4.0  
##  Mode  :character   Mode  :character   Median :4.000   Median :4.0  
##                                        Mean   :4.669   Mean   :4.3  
##                                        3rd Qu.:7.000   3rd Qu.:5.0  
##                                        Max.   :9.000   Max.   :9.0  
##       FFMC             DMC               DC              ISI        
##  Min.   :18.70   Min.   :  1.1   Min.   :  7.9   Min.   : 0.000  
##  1st Qu.:90.20   1st Qu.: 68.6   1st Qu.:437.7   1st Qu.: 6.500  
##  Median :91.60   Median :108.3   Median :664.2   Median : 8.400  
##  Mean   :90.64   Mean   :110.9   Mean   :547.9   Mean   : 9.022  
##  3rd Qu.:92.90   3rd Qu.:142.4   3rd Qu.:713.9   3rd Qu.:10.800  
##  Max.   :96.20   Max.   :291.3   Max.   :860.6   Max.   :56.100  
##       temp             RH              wind            rain         
##  Min.   : 2.20   Min.   : 15.00   Min.   :0.400   Min.   :0.00000  
##  1st Qu.:15.50   1st Qu.: 33.00   1st Qu.:2.700   1st Qu.:0.00000  
##  Median :19.30   Median : 42.00   Median :4.000   Median :0.00000  
##  Mean   :18.89   Mean   : 44.29   Mean   :4.018   Mean   :0.02166  
##  3rd Qu.:22.80   3rd Qu.: 53.00   3rd Qu.:4.900   3rd Qu.:0.00000  
##  Max.   :33.30   Max.   :100.00   Max.   :9.400   Max.   :6.40000  
##       area          fire_yes_no    
##  Min.   :   0.00   Min.   :0.0000  
##  1st Qu.:   0.00   1st Qu.:0.0000  
##  Median :   0.52   Median :1.0000  
##  Mean   :  12.85   Mean   :0.5203  
##  3rd Qu.:   6.57   3rd Qu.:1.0000  
##  Max.   :1090.84   Max.   :1.0000
```

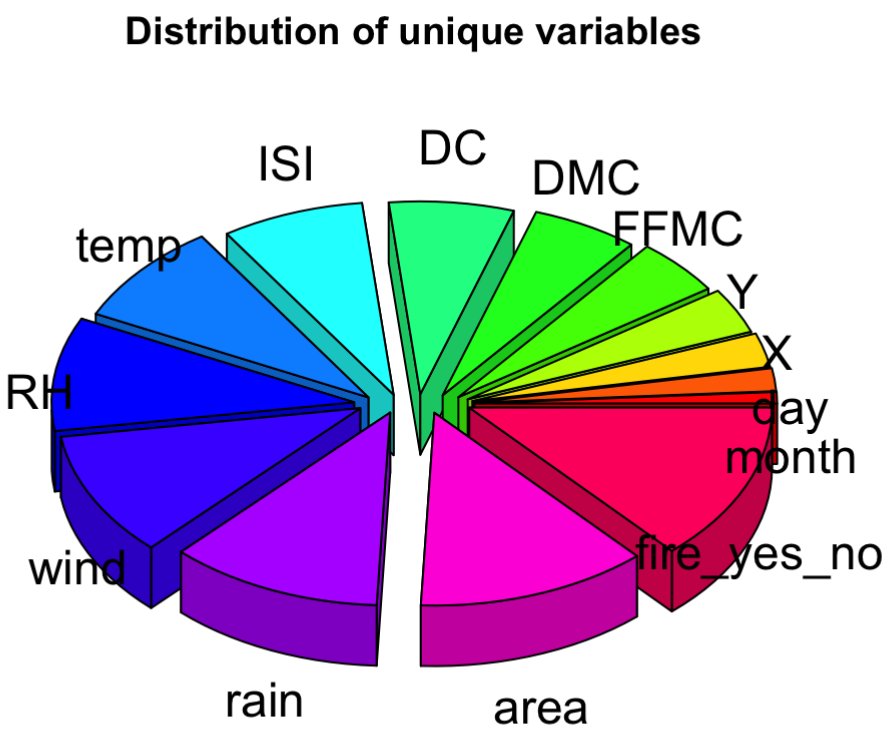
```
(head(forestfires,n=5))
```

```
## # A tibble: 5 x 14
##   month day       X     Y  FFMC   DMC    DC   ISI  temp    RH  wind  rain
##   <chr> <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 mar   fri       7     5  86.2  26.2  94.3   5.1   8.2    51   6.7   0  
## 2 oct   tue       7     4  90.6  35.4 669.    6.7  18      33   0.9   0  
## 3 oct   sat       7     4  90.6  43.7 687.    6.7  14.6    33   1.3   0  
## 4 mar   fri       8     6  91.7  33.3  77.5   9     8.3    97   4     0.2
## 5 mar   sun       8     6  89.3  51.3 102.    9.6  11.4    99   1.8   0  
## # … with 2 more variables: area <dbl>, fire_yes_no <dbl>
```

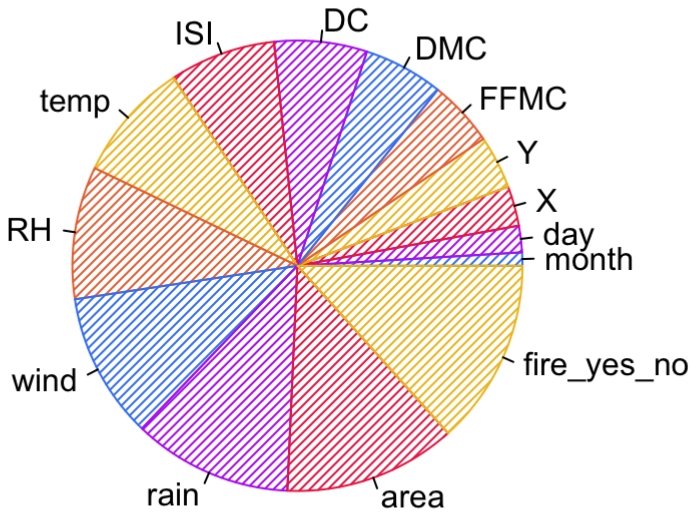
```
# Save col names in a variable
colnamesff <- colnames(forestfires)


## EDA ##

# Plot unique variables 3d
slices <- c(1:14)
lbls <- colnamesff
#pie3D(slices,labels=lbls,explode=0.2,theta=1,radius = 1, main="Distribution of unique v
ariables")
pie3D(slices,labels=lbls,explode=0.2,theta=1,radius = 1, main="Distribution of unique va
riables")
```




```
# Plot unique variables 2d
colors = c('#4286f4','#bb3af2','#ed2f52','#efc023','#ea7441')
pie(slices, lbls, main='Distribution of unique variables',density=30 ,col=colors, angle=
45)
```




```
## Check for missing data and make sure no missing data
forestfires[!complete.cases(forestfires),]
```

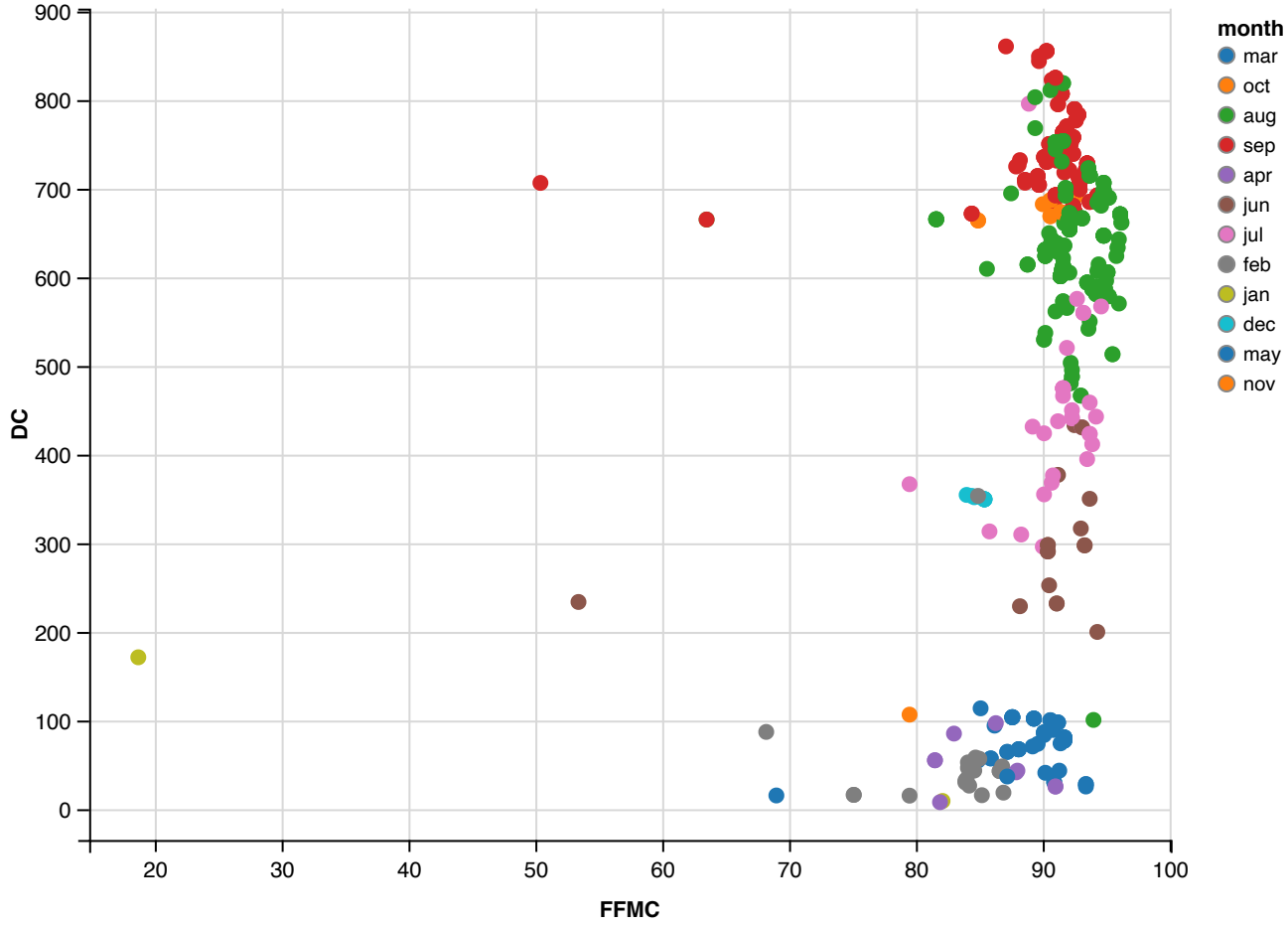
```
## # A tibble: 0 x 14
## # … with 14 variables: month <chr>, day <chr>, X <dbl>, Y <dbl>,
## #   FFMC <dbl>, DMC <dbl>, DC <dbl>, ISI <dbl>, temp <dbl>, RH <dbl>,
## #   wind <dbl>, rain <dbl>, area <dbl>, fire_yes_no <dbl>
```

```
sum(is.na(forestfires))
```

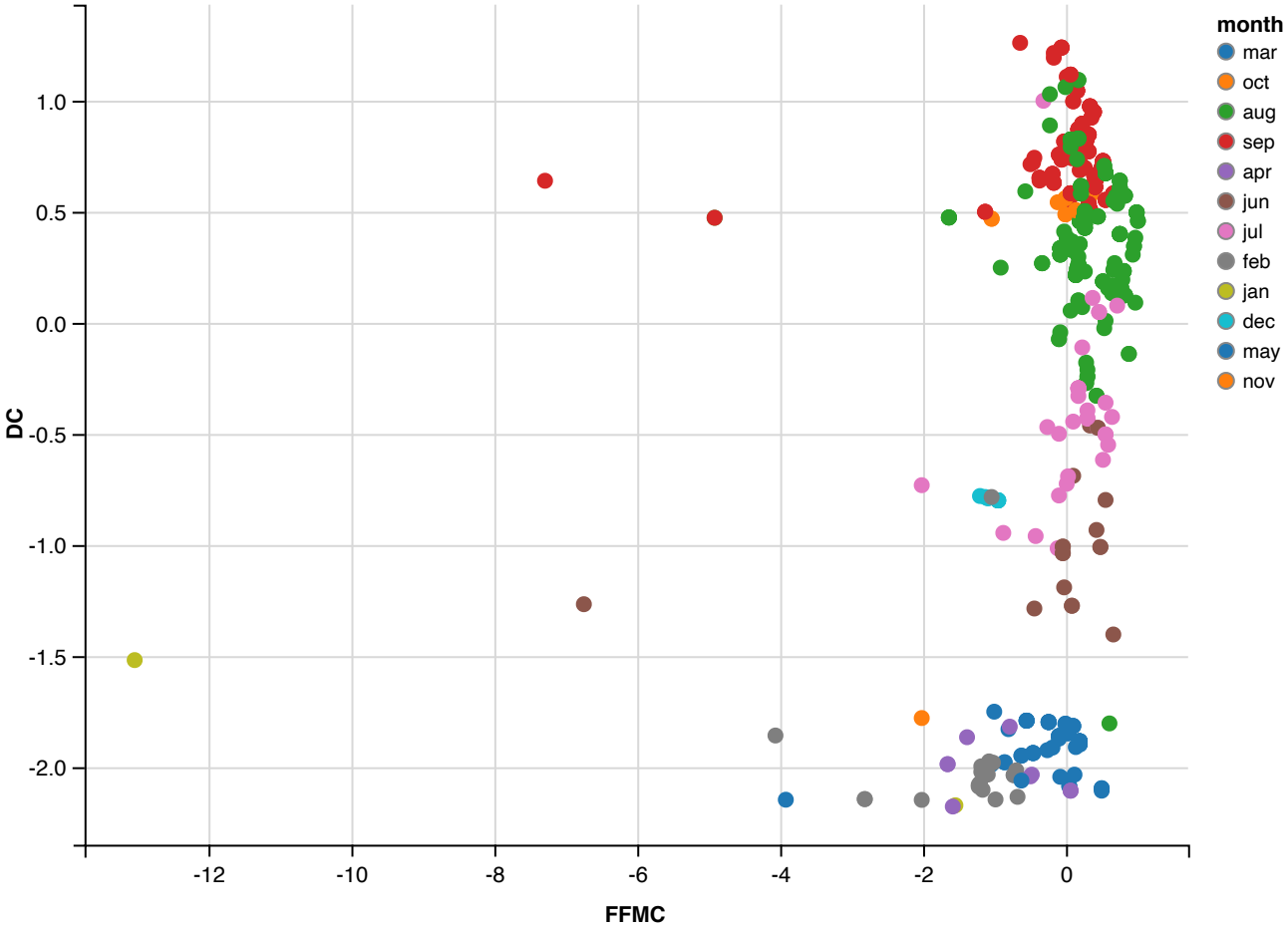
```
## [1] 0
```

```
# Create a scatter plot with  variables FFMC and DC filled by month
## View difference between scaled and not scaled

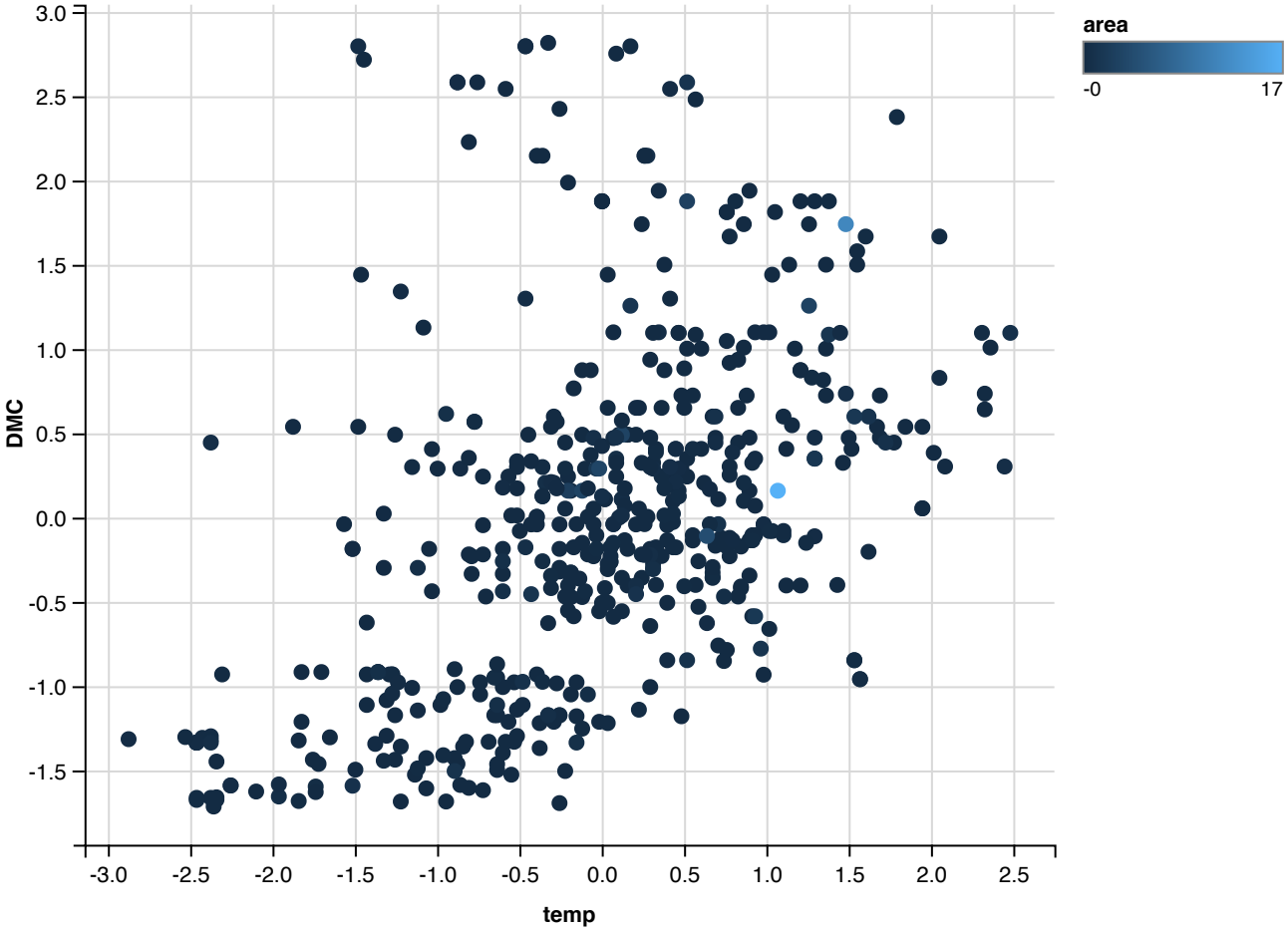

forestfires_na_factor %>% ggvis(~FFMC, ~DC, fill = ~month) %>% layer_points() # possible
2 or 3 key clusters
```




```
forestfires.scaled %>% ggvis(~FFMC, ~DC,fill=~month)%>% layer_points()
```




```
# Any cluster between Temp and DC?
forestfires.scaled %>% ggvis(~temp, ~DMC, fill = ~area) %>% layer_points()
```


area
-0
17
DMC
temp
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5

```
## Visual Clusters found  in DC and FFMC !!
## 1 months aug, sep, nov
## 2 july, june, DEC
### 3 feb,march, april

# if chr, change to factor using dplyr

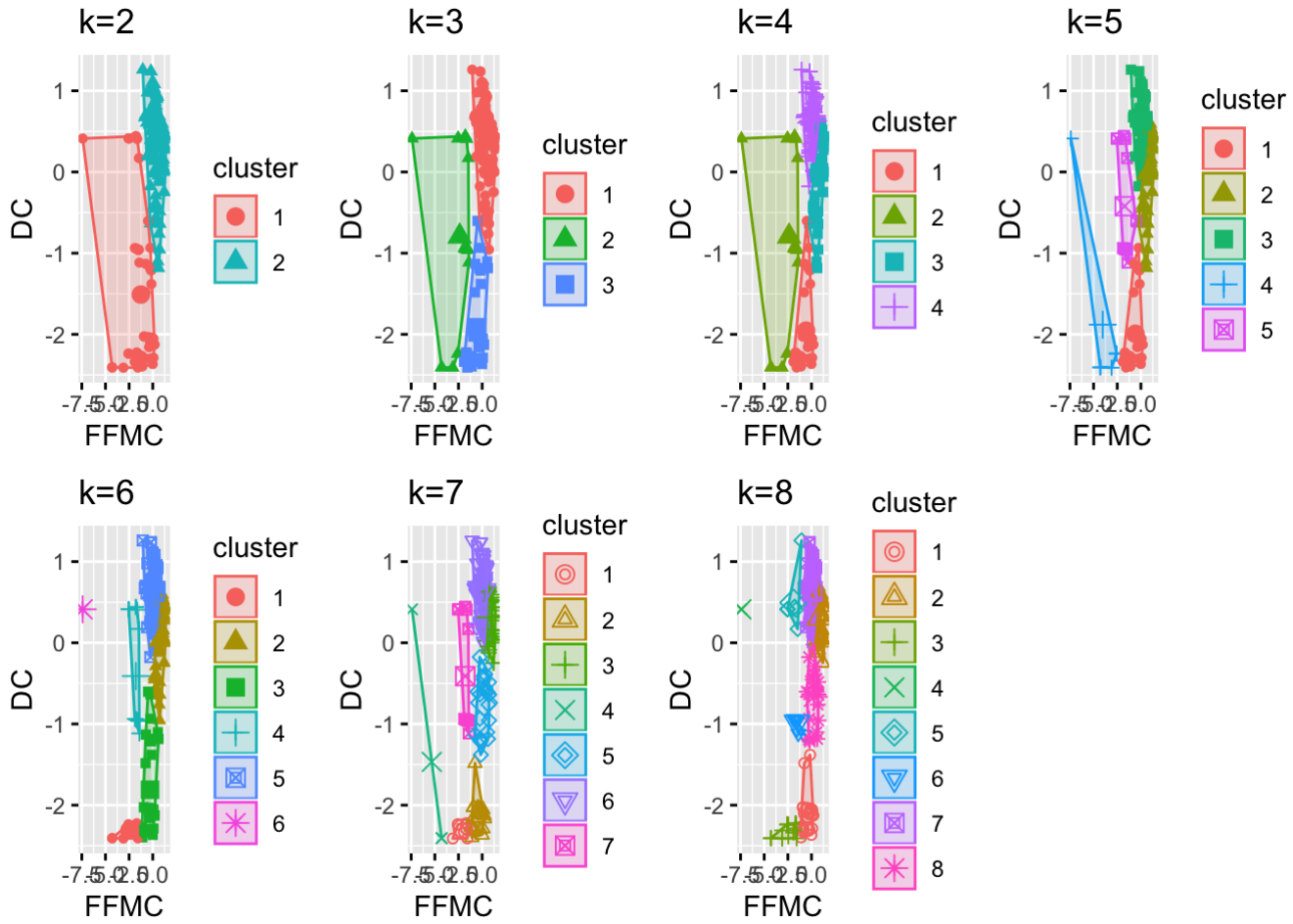
#cluster <- select_(forestfires.scaled,-c(X,Y,month,day))

# create a dataframe for clusting
## Only keep of interest variables and drop the rest of them !!
# cluster_scaled <- select(forestfiresmm.scaled,-c(X,Y,month,day,DMC,ISI,temp,RH,wind,ra
in,area,fire_yes_no))
cluster_scaled <- dplyr::select(forestfiresmm.scaled,c(5,7))

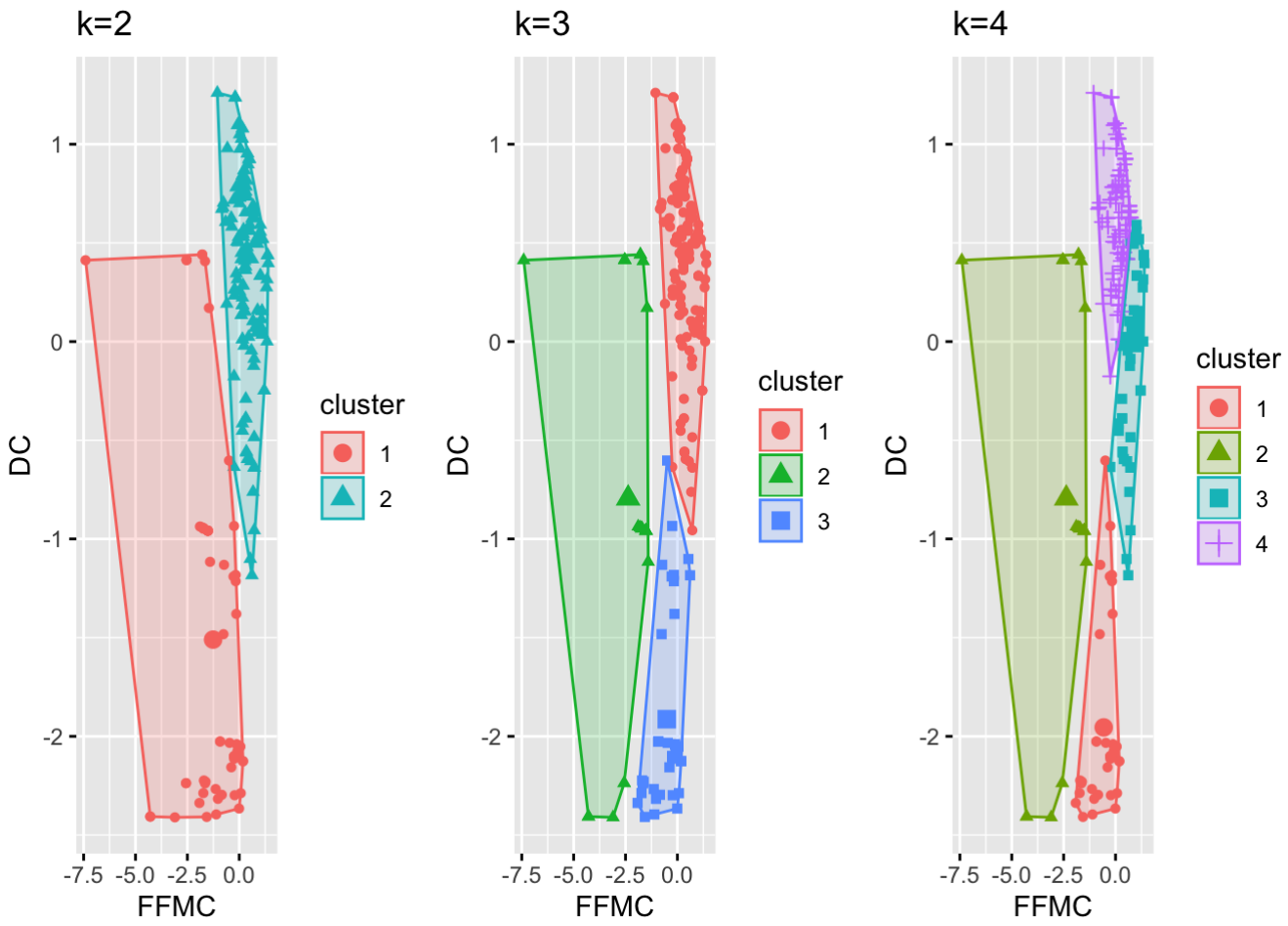
# use scaled data since k means is a distance measure
k1 = kmeans(cluster_scaled,centers = 2, nstart = 25)
k2 = kmeans(cluster_scaled,centers = 3, nstart = 25)
k3 = kmeans(cluster_scaled,centers = 4, nstart = 25)
k4 = kmeans(cluster_scaled,centers = 5, nstart = 25)
k5 = kmeans(cluster_scaled,centers = 6, nstart = 25)
k6 = kmeans(cluster_scaled,centers = 7, nstart = 25)
k7 = kmeans(cluster_scaled,centers = 8, nstart = 25)

# plot to compare
p1 <- fviz_cluster(k1,geom = "point", cluster_scaled)+ggtitle("k=2")
p2 <- fviz_cluster(k2,geom = "point", cluster_scaled)+ggtitle("k=3")
p3 <- fviz_cluster(k3,geom = "point", cluster_scaled)+ggtitle("k=4")
p4 <- fviz_cluster(k4,geom = "point", cluster_scaled)+ggtitle("k=5")
p5 <- fviz_cluster(k5,geom = "point", cluster_scaled)+ggtitle("k=6")
p6 <- fviz_cluster(k6,geom = "point", cluster_scaled)+ggtitle("k=7")
p7 <- fviz_cluster(k7,geom = "point", cluster_scaled)+ggtitle("k=8")

 # for a grid layout
grid.arrange(p1,p2,p3,p4,p5,p6,p7,nrow=2)
```




```
grid.arrange(p1,p2,p3,nrow=1)
```



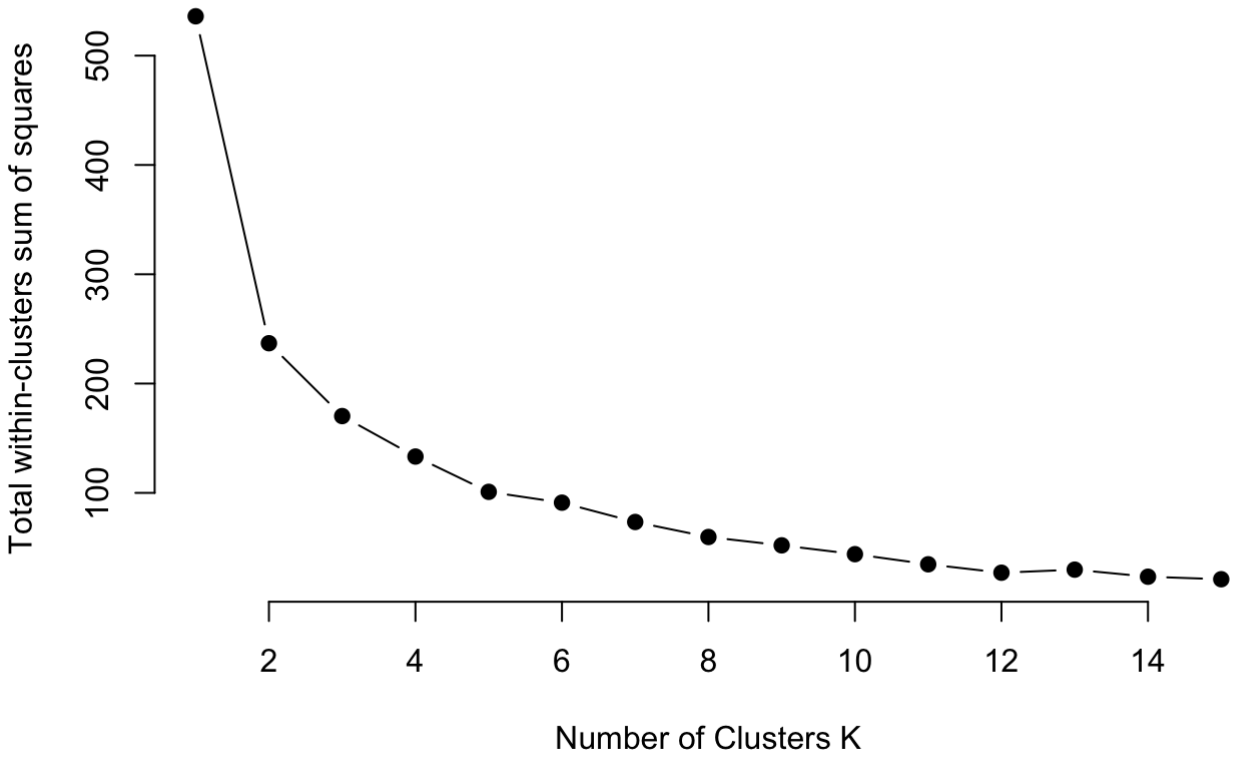

```
### Analyze the cluster results

# Function to compute total within cluster sum of square
wss = function(k){kmeans(cluster_scaled,k,nstart = 10)$tot.withinss}

#Compute and plot wss for k =1 to k =15
k.values = 1:15

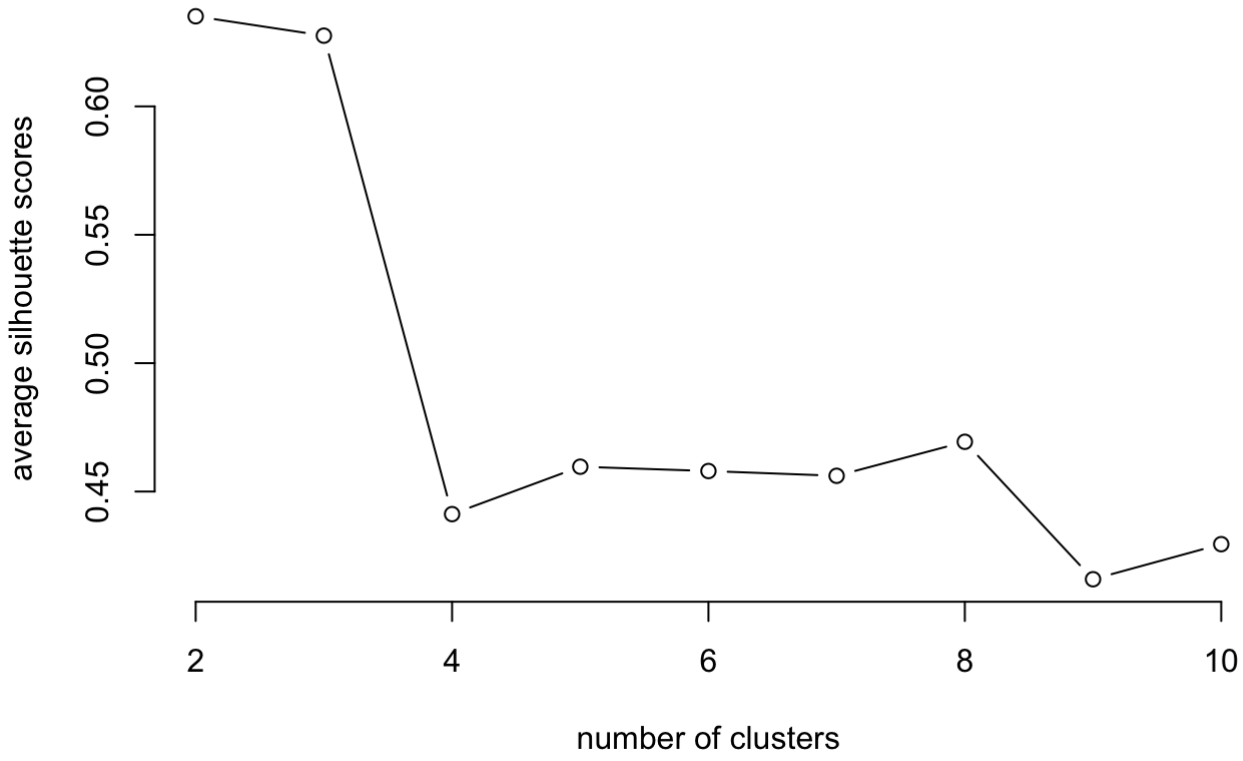
# Extract wsss for 2-15 clusters
wss_values = map_dbl(k.values,wss)

plot(k.values, wss_values,
     type = "b", pch = 19, frame = FALSE,
     main="Elbow Plot of K-Means Clustering",
     xlab="Number of Clusters K",
     ylab="Total within-clusters sum of squares")
```

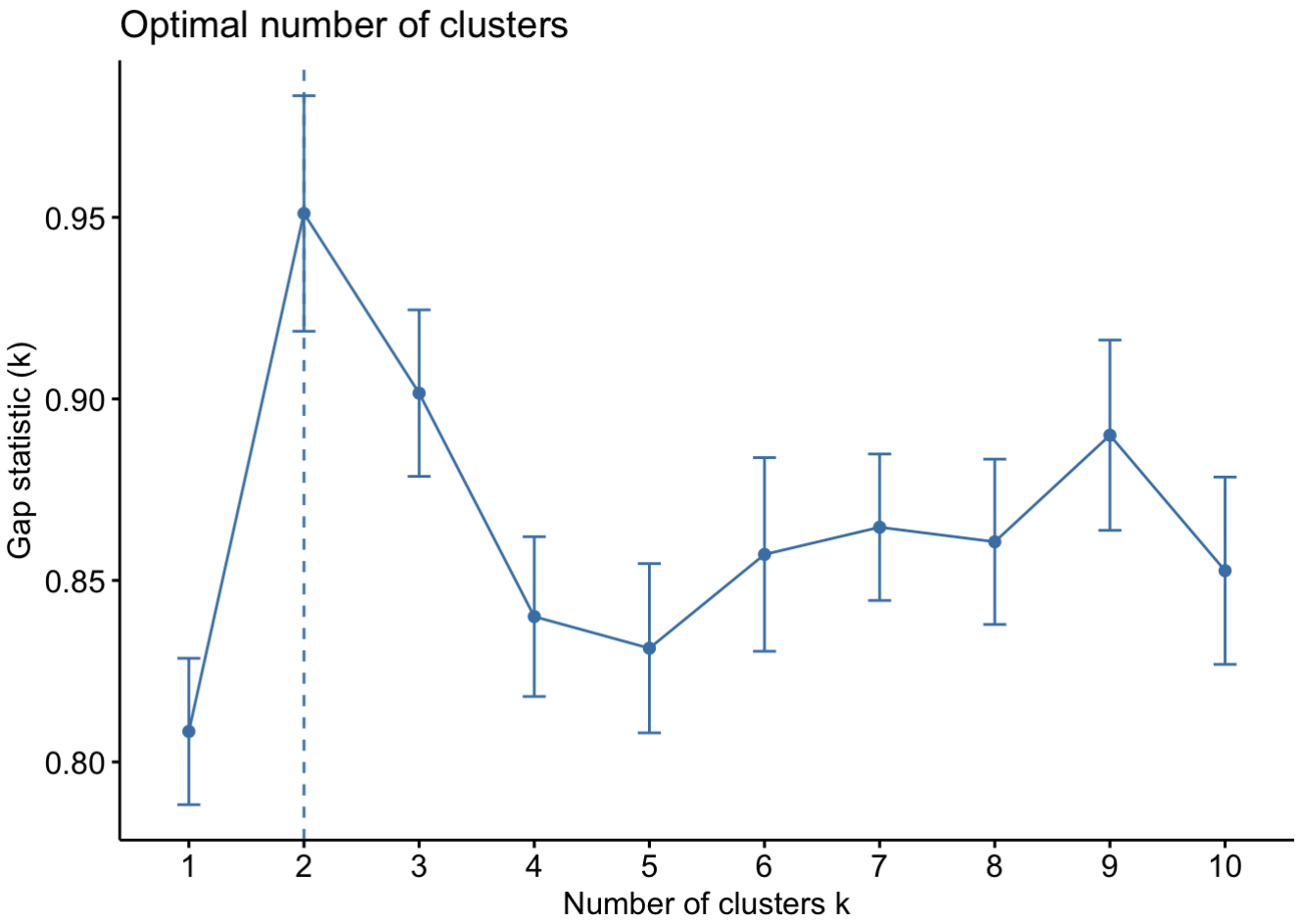



```
# Silhoette scores
silhouette_score = function(k){
  km = kmeans(cluster_scaled, centers = k, nstart = 25)
  ss = silhouette(km$cluster,dist(cluster_scaled))
  mean(ss[,3])
}

k=2:10
avg_sil = sapply(k,silhouette_score)
plot(k,type = 'b',avg_sil,xlab = 'number of clusters',ylab = 'average silhouette scores'
, main="Silhouette Plot of K-Means Clustering",frame ='False')
```




```
# Gap statistic
fviz_nbclust(cluster_scaled,kmeans,method = "gap_stat")
```




```
# -->  shows 2 optimal clusters

## View stats within a cluster

cluster_2 <- kmeans(cluster_scaled,centers = 2,nstart = 10)
cluster_2$cluster <- as.factor(cluster_2$cluster)
cluster_2
```

```
## K-means clustering with 2 clusters of sizes 60, 209
##
## Cluster means:
##         FFMC         DC
## 1 -1.2621146 -1.5100174
## 2  0.3623295  0.4334978
##
## Clustering vector:
##   [1] 1 2 2 2 2 1 2 2 1 1 2 2 2 1 2 2 2 2 2 2 2 1 2 1 2 2 1 2 2 1 2 2 1 2
##  [36] 2 2 2 1 2 2 2 2 1 1 2 2 2 1 2 1 1 1 2 2 2 2 2 1 2 2 1 2 1 1 2 1 2 2 2
##  [71] 2 2 2 2 2 2 1 1 1 2 2 2 1 2 2 1 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2
## [106] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1 2 2 2 2
## [141] 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
## [176] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 1 2 2 2
## [211] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 2 2 2
## [246] 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1
## Levels: 1 2
##
## Within cluster sum of squares by cluster:
## [1] 151.7523  85.1491
##  (between_SS / total_SS =  55.8 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
cluster_3 <- kmeans(cluster_scaled,centers = 3,nstart = 10)
cluster_3$cluster <- as.factor(cluster_3$cluster)
cluster_3
```

```
## K-means clustering with 3 clusters of sizes 207, 23, 39
##
## Cluster means:
##         FFMC         DC
## 1  0.3603208  0.4487290
## 2 -2.3744327 -0.7942261
## 3 -0.5121656 -1.9133255
##
## Clustering vector:
##   [1] 2 1 1 1 1 3 1 1 3 2 1 1 1 3 1 1 1 1 1 1 1 1 3 1 3 1 1 3 1 1 3 1 1 2 1
##  [36] 1 1 1 2 1 1 1 1 2 3 1 1 1 3 1 3 3 3 1 1 1 1 1 2 1 1 2 1 3 3 1 3 1 1 1
##  [71] 1 1 1 1 1 3 3 3 1 1 1 3 1 1 3 3 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1
## [106] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 3 3 1 1 1 1
## [141] 3 3 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 1 1 1 1 1 1 1
## [176] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 1 1 3 1 1 3 1 1 1 1 3 1 1 1
## [211] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 1 1 1 1 1 1 1 2 2 2 3 3 3 3 3 3 3 3 1 1
## [246] 1 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2
## Levels: 1 2 3
##
## Within cluster sum of squares by cluster:
## [1] 80.03692 65.03808 25.18623
##  (between_SS / total_SS =  68.2 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
cluster_4 <- kmeans(cluster_scaled,centers = 4,nstart = 10)
cluster_4$cluster <- as.factor(cluster_4$cluster)
cluster_4
```

```
## K-means clustering with 4 clusters of sizes 23, 72, 137, 37
##
## Cluster means:
##         FFMC          DC
## 1 -2.3744327 -0.79422614
## 2  0.8120772  0.05189641
## 3  0.1259658  0.63404748
## 4 -0.5706735 -1.95496878
##
## Clustering vector:
##   [1] 1 3 3 2 3 4 2 2 4 1 2 2 2 4 2 2 3 2 3 3 3 3 4 2 4 3 3 4 3 2 4 2 3 1 3
##  [36] 3 3 3 1 3 3 3 3 1 4 3 2 3 4 3 4 4 4 2 2 3 2 2 1 3 3 1 3 4 4 3 4 3 2 3
##  [71] 3 2 3 2 2 4 4 4 3 3 3 4 3 3 4 4 3 3 3 2 3 2 3 3 3 1 3 3 3 3 3 2 3 3 2
## [106] 2 2 2 2 2 3 2 2 3 2 3 3 3 2 2 2 3 3 3 3 1 1 1 1 1 1 1 1 4 4 2 2 2 2
## [141] 4 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [176] 3 3 3 3 3 3 3 3 3 3 3 2 2 3 2 3 3 3 3 2 4 3 3 4 3 3 2 3 3 3 3 4 2 2 2
## [211] 3 3 3 3 3 2 3 3 3 3 3 2 3 3 4 3 2 3 3 2 3 3 1 1 1 4 4 4 4 4 4 4 2 2 2
## [246] 2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 1 1 1
## Levels: 1 2 3 4
##
## Within cluster sum of squares by cluster:
## [1] 65.03808 22.60481 24.33197 21.45854
##  (between_SS / total_SS =  75.1 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
cluster_5 <- kmeans(cluster_scaled,centers = 5,nstart = 10)
cluster_5$cluster <- as.factor(cluster_5$cluster)
cluster_5
```

```
## K-means clustering with 5 clusters of sizes 4, 141, 64, 49, 11
##
## Cluster means:
##         FFMC           DC
## 1 -4.7720552 -1.702911773
## 2  0.1830428  0.622243620
## 3  0.8338975 -0.007036539
## 4 -0.8641367 -1.765087342
## 5 -1.6134145  0.546810450
##
## Clustering vector:
##   [1] 4 2 2 3 2 4 3 3 4 5 3 3 3 4 3 3 2 3 2 2 2 2 4 3 4 2 2 4 2 3 4 3 2 5 2
##  [36] 2 2 2 4 2 2 2 2 5 4 2 3 2 4 2 4 4 4 3 3 2 3 3 4 2 2 1 2 4 4 2 4 2 3 2
##  [71] 2 3 2 3 3 4 4 4 2 2 2 4 2 2 4 4 2 2 2 3 2 3 2 2 2 5 2 2 2 2 2 3 2 2 3
## [106] 2 2 2 2 3 2 3 3 2 3 2 2 2 3 3 3 2 2 2 2 4 4 4 4 4 4 4 4 4 4 3 3 3 3
## [141] 4 4 2 2 2 2 2 2 2 2 2 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
## [176] 2 2 5 2 2 2 2 2 2 2 2 2 3 2 3 2 2 2 2 3 4 2 2 4 2 2 3 2 5 5 2 4 3 3 3
## [211] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 4 2 3 2 2 2 2 2 1 1 1 4 4 4 4 4 4 4 3 3 3
## [246] 3 3 4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 2 2 5 5 5
## Levels: 1 2 3 4 5
##
## Within cluster sum of squares by cluster:
## [1] 16.174952 21.818887 20.189557 44.367355  5.760022
##  (between_SS / total_SS =  79.8 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
cluster_6 <- kmeans(cluster_scaled,centers = 6,nstart = 10)
cluster_6$cluster <- as.factor(cluster_6$cluster)
cluster_6
```

```
## K-means clustering with 6 clusters of sizes 36, 6, 17, 49, 58, 103
##
## Cluster means:
##         FFMC          DC
## 1 -0.5728355 -1.99253193
## 2 -4.0364254 -1.88103378
## 3 -1.7878471 -0.41064697
## 4 -0.1374781  0.32913614
## 5  0.8904067  0.00130322
## 6  0.2944356  0.71645722
##
## Clustering vector:
##   [1] 3 4 4 5 4 1 5 5 1 3 5 6 5 1 4 5 6 5 6 6 6 6 1 5 1 6 4 1 6 5 1 5 6 3 4
##  [36] 4 4 4 2 4 4 4 6 3 1 6 5 4 1 4 1 1 1 5 5 6 5 5 2 6 4 2 4 1 1 4 1 6 5 4
##  [71] 6 6 4 5 5 1 1 1 6 4 6 1 4 6 1 1 4 6 6 5 6 5 6 6 4 3 6 4 6 4 6 5 6 6 5
## [106] 6 6 6 6 4 4 5 5 6 5 4 4 4 5 5 5 6 6 6 6 3 3 3 3 3 3 3 3 1 1 4 4 5 5
## [141] 1 1 4 4 6 6 6 6 6 6 6 6 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
## [176] 6 6 4 6 6 6 6 6 6 6 6 6 5 4 5 6 6 4 6 5 1 6 6 1 6 4 5 6 4 4 6 1 5 5 5
## [211] 6 4 4 4 6 6 6 4 4 6 6 6 6 6 1 6 5 4 4 6 6 6 2 2 2 1 1 1 1 1 1 5 5 5
## [246] 5 5 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 6 6 6 3 3 3
## Levels: 1 2 3 4 5 6
##
## Within cluster sum of squares by cluster:
## [1] 19.572879 23.049495  9.977696 11.341690 16.239870 10.868578
##  (between_SS / total_SS =  83.0 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
cluster_7 <- kmeans(cluster_scaled,centers = 7,nstart = 10)
cluster_7$cluster <- as.factor(cluster_7$cluster)
cluster_7
```

```
## K-means clustering with 7 clusters of sizes 129, 24, 26, 1, 11, 61, 17
##
## Cluster means:
##         FFMC         DC
## 1  0.1002921  0.6386159
## 2  0.2472720 -0.6657184
## 3 -0.3675930 -2.0570902
## 4 -7.4095568  0.4121876
## 5 -2.4550662 -2.3112612
## 6  0.9097359  0.3126691
## 7 -1.7878471 -0.4106470
##
## Clustering vector:
##   [1] 7 1 1 6 2 2 6 6 3 7 6 6 2 2 2 6 6 6 6 1 1 1 3 6 3 1 1 5 1 6 3 6 1 7 1
##  [36] 1 1 1 5 1 1 1 1 7 3 1 6 1 3 1 3 3 3 6 6 1 6 6 5 1 1 4 1 3 5 1 3 1 6 1
##  [71] 1 6 1 6 6 3 3 3 1 1 1 3 1 6 3 3 1 6 1 2 6 2 1 6 1 7 1 1 1 1 1 6 1 1 2
## [106] 6 6 6 6 2 1 6 6 1 6 1 1 1 6 6 6 1 1 1 1 7 7 7 7 7 7 7 7 3 5 2 2 2 2
## [141] 2 2 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 1 1 1 1 1 1 1
## [176] 1 1 1 1 1 1 1 1 1 1 1 6 2 1 6 1 1 1 1 6 5 1 1 5 1 1 2 1 1 1 1 5 2 6 6
## [211] 1 1 1 1 1 6 1 1 1 6 1 6 1 1 3 1 6 1 1 6 1 1 5 5 5 3 3 3 3 3 3 3 2 2 2
## [246] 2 2 2 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 1 1 1 7 7 7
## Levels: 1 2 3 4 5 6 7
##
## Within cluster sum of squares by cluster:
## [1] 21.487796  5.950791  6.588888  0.000000 10.730567  7.930224  9.977696
##  (between_SS / total_SS =  88.3 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

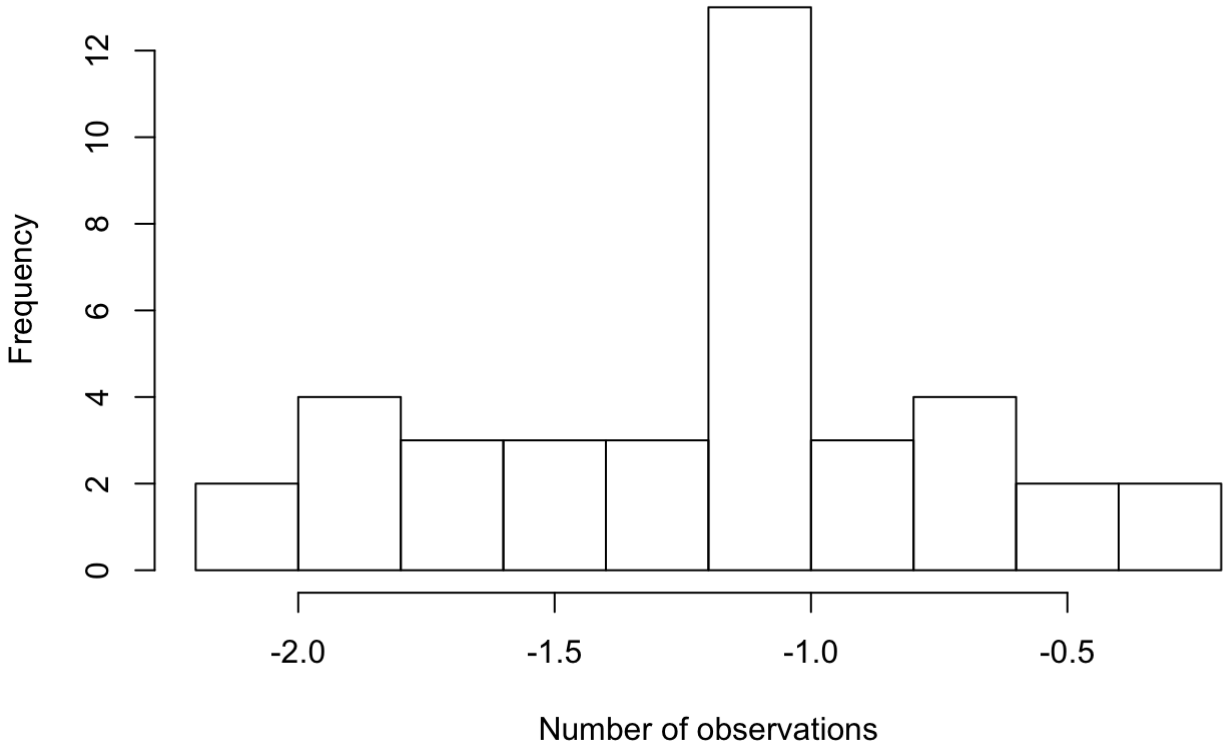
```
# cluster_2df <- as.data.frame.complex(cluster_2)
# ggplot(cluster_2, aes(color=cluster_2$cluster))+geom_point()

# ggplot(cluster_3, aes(W1,W44,color =cluster_3$cluster)) +geom_point()


# View counts within cluster
group1 = data.frame(t(cluster_scaled[cluster_3$cluster == 3,]))
summary(sapply(group1, mean))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -2.1284 -1.5222 -1.1758 -1.2127 -0.9731 -0.2859
```

```
hist(sapply(group1, mean), main = "Histogram of Group 3", xlab = "Number of observation
s")
```




```
## Create a training a test set with scaled data
ind <- sample(2, nrow(forestfires.scaled), replace=TRUE, prob=c(0.67, 0.33)) # Randomize
(SHUFFLE) data
forestfires.scaled.training <- forestfires.scaled[ind==1, 4:11]
forestfires.scaled.test <- forestfires.scaled[ind==2, 4:11]
forestfires.scaled.trainLabels <- forestfires.scaled[ind==1, 3]
forestfires.scaled.testLabels <- forestfires.scaled[ind==2, 3]

## MORE TRANSFORMATION of the data using DPLYR

# Change OG data into factor
# if numeric, change to factor using dplyr
forestfires <- forestfires %>%
  mutate_if(is.numeric,funs(as.factor))
```

```
## Warning: funs() is soft deprecated as of dplyr 0.8.0
## Please use a list of either functions or lambdas:
##
##   # Simple named list:
##   list(mean = mean, median = median)
##
##   # Auto named with `tibble::lst()`:
##   tibble::lst(mean, median)
##
##   # Using lambdas
##   list(~ mean(., trim = .2), ~ median(., na.rm = TRUE))
## This warning is displayed once per session.
```

```
str(forestfires)
```

```
## Classes 'spec_tbl_df', 'tbl_df', 'tbl' and 'data.frame': 517 obs. of  14 variables:
##  $ month      : chr  "mar" "oct" "oct" "mar" ...
##  $ day        : chr  "fri" "tue" "sat" "fri" ...
##  $ X          : Factor w/ 9 levels "1","2","3","4",..: 7 7 7 8 8 8 8 8 8 7 ...
##  $ Y          : Factor w/ 7 levels "2","3","4","5",..: 4 3 3 5 5 5 5 5 5 4 ...
##  $ FFMC       : Factor w/ 106 levels "18.7","50.4",..: 29 57 57 68 47 74 74 66 61 76
...
##  $ DMC        : Factor w/ 215 levels "1.1","2.4","3",..: 38 50 57 49 67 94 99 168 150
96 ...
##  $ DC         : Factor w/ 219 levels "7.9","9.3","15.3",..: 42 145 157 34 47 92 93 11
9 162 165 ...
##  $ ISI        : Factor w/ 119 levels "0","0.4","0.7",..: 30 43 43 65 69 103 60 77 45
46 ...
##  $ temp       : Factor w/ 192 levels "2.2","4.2","4.6",..: 13 86 56 14 31 126 145 12
43 132 ...
##  $ RH         : Factor w/ 75 levels "15","17","18",..: 35 17 17 73 74 13 11 67 47 24
...
##  $ wind       : Factor w/ 21 levels "0.4","0.9","1.3",..: 15 2 3 9 4 12 7 5 12 9 ...
##  $ rain       : Factor w/ 7 levels "0","0.2","0.4",..: 1 1 1 2 1 1 1 1 1 1 ...
##  $ area       : Factor w/ 251 levels "0","0.09","0.17",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ fire_yes_no: Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 1 1 ...
```

```
# if chr, change to factor using dplyr
forestfires <- forestfires %>%
  mutate_if(is.character,funs(as.factor))
str(forestfires)
```

```
## Classes 'spec_tbl_df', 'tbl_df', 'tbl' and 'data.frame': 517 obs. of  14 variables:
##  $ month      : Factor w/ 12 levels "apr","aug","dec",..: 8 11 11 8 8 2 2 2 12 12 ...
##  $ day        : Factor w/ 7 levels "fri","mon","sat",..: 1 6 3 1 4 4 2 2 6 3 ...
##  $ X          : Factor w/ 9 levels "1","2","3","4",..: 7 7 7 8 8 8 8 8 8 7 ...
##  $ Y          : Factor w/ 7 levels "2","3","4","5",..: 4 3 3 5 5 5 5 5 5 4 ...
##  $ FFMC       : Factor w/ 106 levels "18.7","50.4",..: 29 57 57 68 47 74 74 66 61 76
...
##  $ DMC        : Factor w/ 215 levels "1.1","2.4","3",..: 38 50 57 49 67 94 99 168 150
96 ...
##  $ DC         : Factor w/ 219 levels "7.9","9.3","15.3",..: 42 145 157 34 47 92 93 11
9 162 165 ...
##  $ ISI        : Factor w/ 119 levels "0","0.4","0.7",..: 30 43 43 65 69 103 60 77 45
46 ...
##  $ temp       : Factor w/ 192 levels "2.2","4.2","4.6",..: 13 86 56 14 31 126 145 12
43 132 ...
##  $ RH         : Factor w/ 75 levels "15","17","18",..: 35 17 17 73 74 13 11 67 47 24
...
##  $ wind       : Factor w/ 21 levels "0.4","0.9","1.3",..: 15 2 3 9 4 12 7 5 12 9 ...
##  $ rain       : Factor w/ 7 levels "0","0.2","0.4",..: 1 1 1 2 1 1 1 1 1 1 ...
##  $ area       : Factor w/ 251 levels "0","0.09","0.17",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ fire_yes_no: Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 1 1 ...
```

```
# Nice viz to view any null values

# R for Loop , for value in sequence :: names gives name of a set of object
#:: CAT concatenate and print :: sum,values that are na, in subset of data
colnames(forestfires)
```

```
##  [1] "month"       "day"         "X"           "Y"           "FFMC"
##  [6] "DMC"         "DC"          "ISI"         "temp"        "RH"
## [11] "wind"        "rain"        "area"        "fire_yes_no"
```

```
colname <- colnames(forestfires)

for(colname in names(forestfires)){
  cat("\n","\n Looking at column...", colname)
  NAcount <- sum(is.na(forestfires[colname]))
  cat("\nThe num of missing values in column ", colname, "is  ", NAcount)
}
```

```
##
##
##  Looking at column... month
## The num of missing values in column  month is   0
##
##  Looking at column... day
## The num of missing values in column  day is   0
##
##  Looking at column... X
## The num of missing values in column  X is   0
##
##  Looking at column... Y
## The num of missing values in column  Y is   0
##
##  Looking at column... FFMC
## The num of missing values in column  FFMC is   0
##
##  Looking at column... DMC
## The num of missing values in column  DMC is   0
##
##  Looking at column... DC
## The num of missing values in column  DC is   0
##
##  Looking at column... ISI
## The num of missing values in column  ISI is   0
##
##  Looking at column... temp
## The num of missing values in column  temp is   0
##
##  Looking at column... RH
## The num of missing values in column  RH is   0
##
##  Looking at column... wind
## The num of missing values in column  wind is   0
##
##  Looking at column... rain
## The num of missing values in column  rain is   0
##
##  Looking at column... area
## The num of missing values in column  area is   0
##
##  Looking at column... fire_yes_no
## The num of missing values in column  fire_yes_no is   0
```

```
##### Melt data frame ######
# Drop useless coloumns
forestfires.scaled <- dplyr::select(forestfires.scaled,c(-1,-2))
mdata <- melt(forestfiresmm.scaled,id=c("month","day"))
```

```
## Warning: attributes are not identical across measure variables; they will
## be dropped
```

```
mdata %>% drop_na()
```

```
##      month day    variable         value
## 1      jul tue           X  9.0000000000
## 2      sep tue           X  1.0000000000
## 3      sep mon           X  2.0000000000
## 4      aug wed           X  1.0000000000
## 5      aug fri           X  8.0000000000
## 6      jul sat           X  1.0000000000
## 7      aug wed           X  2.0000000000
## 8      aug thu           X  6.0000000000
## 9      mar mon           X  5.0000000000
## 10     sep tue           X  8.0000000000
## 11     aug tue           X  2.0000000000
## 12     sep thu           X  8.0000000000
## 13     jun fri           X  6.0000000000
## 14     jul sun           X  9.0000000000
## 15     jul sat           X  3.0000000000
## 16     sep fri           X  5.0000000000
## 17     sep sat           X  1.0000000000
## 18     aug sun           X  7.0000000000
## 19     sep sat           X  2.0000000000
## 20     aug wed           X  2.0000000000
## 21     aug wed           X  2.0000000000
## 22     sep fri           X  7.0000000000
## 23     mar mon           X  7.0000000000
## 24     aug thu           X  6.0000000000
## 25     mar sat           X  6.0000000000
## 26     sep sat           X  8.0000000000
## 27     sep sun           X  8.0000000000
## 28     mar thu           X  6.0000000000
## 29     aug wed           X  6.0000000000
## 30     aug wed           X  6.0000000000
## 31     mar fri           X  6.0000000000
## 32     aug thu           X  8.0000000000
## 33     sep wed           X  5.0000000000
## 34     aug wed           X  8.0000000000
## 35     aug sun           X  7.0000000000
## 36     sep mon           X  4.0000000000
## 37     aug sat           X  1.0000000000
## 38     aug sat           X  1.0000000000
## 39     apr thu           X  6.0000000000
## 40     aug sun           X  2.0000000000
## 41     sep wed           X  2.0000000000
## 42     aug tue           X  8.0000000000
## 43     sep sun           X  1.0000000000
## 44     oct mon           X  8.0000000000
## 45     feb sun           X  5.0000000000
## 46     oct mon           X  7.0000000000
## 47     aug fri           X  8.0000000000
## 48     sep tue           X  2.0000000000
## 49     mar sun           X  8.0000000000
## 50     sep mon           X  1.0000000000
## 51     mar sat           X  6.0000000000
## 52     mar sun           X  7.0000000000
```

```
## 53     mar fri           X  6.0000000000
## 54     aug thu           X  2.0000000000
## 55     aug tue           X  2.0000000000
## 56     sep wed           X  4.0000000000
## 57     aug tue           X  2.0000000000
## 58     aug fri           X  2.0000000000
## 59     apr thu           X  6.0000000000
## 60     sep thu           X  4.0000000000
## 61     sep tue           X  3.0000000000
## 62     sep mon           X  2.0000000000
## 63     sep tue           X  1.0000000000
## 64     mar sun           X  6.0000000000
## 65     feb sun           X  7.0000000000
## 66     oct wed           X  8.0000000000
## 67     mar sat           X  5.0000000000
## 68     sep thu           X  4.0000000000
## 69     aug sat           X  2.0000000000
## 70     sep tue           X  7.0000000000
## 71     sep fri           X  6.0000000000
## 72     sep thu           X  8.0000000000
## 73     oct sat           X  4.0000000000
## 74     aug sat           X  7.0000000000
## 75     sep fri           X  7.0000000000
## 76     mar mon           X  7.0000000000
## 77     mar sat           X  4.0000000000
## 78     mar sat           X  4.0000000000
## 79     sep sun           X  4.0000000000
## 80     sep mon           X  1.0000000000
## 81     sep wed           X  4.0000000000
## 82     mar mon           X  6.0000000000
## 83     aug sun           X  8.0000000000
## 84     sep fri           X  3.0000000000
## 85     mar mon           X  4.0000000000
## 86     jul fri           X  2.0000000000
## 87     sep wed           X  7.0000000000
## 88     sep sun           X  4.0000000000
## 89     oct mon           X  7.0000000000
## 90     aug sat           X  8.0000000000
## 91     sep sun           X  4.0000000000
## 92     aug sat           X  8.0000000000
## 93     sep wed           X  4.0000000000
## 94     sep sun           X  1.0000000000
## 95     sep tue           X  6.0000000000
## 96     sep tue           X  9.0000000000
## 97     sep sat           X  4.0000000000
## 98     aug sun           X  8.0000000000
## 99     sep sat           X  2.0000000000
## 100    sep tue           X  1.0000000000
## 101    sep sat           X  6.0000000000
## 102    aug sun           X  2.0000000000
## 103    aug sun           X  2.0000000000
## 104    aug sun           X  3.0000000000
## 105    aug wed           X  2.0000000000
## 106    aug wed           X  3.0000000000
```

```
## 107    aug wed           X  8.0000000000
## 108    aug wed           X  8.0000000000
## 109    aug wed           X  6.0000000000
## 110    aug thu           X  7.0000000000
## 111    aug thu           X  6.0000000000
## 112    aug sat           X  8.0000000000
## 113    aug sat           X  4.0000000000
## 114    aug sat           X  7.0000000000
## 115    aug mon           X  2.0000000000
## 116    aug fri           X  3.0000000000
## 117    aug fri           X  2.0000000000
## 118    aug fri           X  6.0000000000
## 119    aug fri           X  4.0000000000
## 120    aug tue           X  4.0000000000
## 121    aug tue           X  6.0000000000
## 122    aug tue           X  4.0000000000
## 123    aug tue           X  2.0000000000
## 124    aug tue           X  8.0000000000
## 125    aug tue           X  2.0000000000
## 126    dec sun           X  4.0000000000
## 127    dec wed           X  8.0000000000
## 128    dec thu           X  4.0000000000
## 129    dec mon           X  4.0000000000
## 130    dec mon           X  3.0000000000
## 131    dec mon           X  4.0000000000
## 132    dec mon           X  4.0000000000
## 133    dec fri           X  4.0000000000
## 134    dec tue           X  6.0000000000
## 135    feb wed           X  3.0000000000
## 136    feb fri           X  5.0000000000
## 137    jul sat           X  9.0000000000
## 138    jul fri           X  4.0000000000
## 139    jul tue           X  7.0000000000
## 140    jul tue           X  8.0000000000
## 141    jun sun           X  6.0000000000
## 142    jun mon           X  6.0000000000
## 143    sep sun           X  7.0000000000
## 144    sep sun           X  3.0000000000
## 145    sep sun           X  6.0000000000
## 146    sep wed           X  4.0000000000
## 147    sep thu           X  4.0000000000
## 148    sep thu           X  5.0000000000
## 149    sep thu           X  6.0000000000
## 150    sep thu           X  1.0000000000
## 151    sep thu           X  6.0000000000
## 152    sep thu           X  3.0000000000
## 153    sep thu           X  6.0000000000
## 154    sep sat           X  4.0000000000
## 155    sep sat           X  3.0000000000
## 156    sep sat           X  7.0000000000
## 157    sep sat           X  4.0000000000
## 158    sep mon           X  1.0000000000
## 159    sep mon           X  6.0000000000
## 160    sep mon           X  8.0000000000
```

```
## 161    sep mon           X  2.0000000000
## 162    sep mon           X  2.0000000000
## 163    sep mon           X  8.0000000000
## 164    sep mon           X  6.0000000000
## 165    sep mon           X  2.0000000000
## 166    sep mon           X  1.0000000000
## 167    sep fri           X  5.0000000000
## 168    sep fri           X  5.0000000000
## 169    sep fri           X  4.0000000000
## 170    sep fri           X  7.0000000000
## 171    sep fri           X  7.0000000000
## 172    sep fri           X  7.0000000000
## 173    sep fri           X  4.0000000000
## 174    sep fri           X  4.0000000000
## 175    sep fri           X  1.0000000000
## 176    sep fri           X  6.0000000000
## 177    sep fri           X  4.0000000000
## 178    sep fri           X  7.0000000000
## 179    sep tue           X  4.0000000000
## 180    sep tue           X  6.0000000000
## 181    sep tue           X  6.0000000000
## 182    sep tue           X  4.0000000000
## 183    sep sat           X  6.0000000000
## 184    sep sun           X  7.0000000000
## 185    sep fri           X  6.0000000000
## 186    sep sat           X  6.0000000000
## 187    aug sat           X  2.0000000000
## 188    jul wed           X  5.0000000000
## 189    aug thu           X  8.0000000000
## 190    aug wed           X  8.0000000000
## 191    aug thu           X  9.0000000000
## 192    aug sat           X  8.0000000000
## 193    aug sun           X  2.0000000000
## 194    sep sun           X  3.0000000000
## 195    aug fri           X  6.0000000000
## 196    feb mon           X  7.0000000000
## 197    sep fri           X  8.0000000000
## 198    sep sun           X  1.0000000000
## 199    feb sun           X  4.0000000000
## 200    sep sun           X  4.0000000000
## 201    aug sun           X  5.0000000000
## 202    jun wed           X  9.0000000000
## 203    sep thu           X  3.0000000000
## 204    sep wed           X  2.0000000000
## 205    sep sat           X  6.0000000000
## 206    sep fri           X  4.0000000000
## 207    feb fri           X  7.0000000000
## 208    jul mon           X  9.0000000000
## 209    aug thu           X  8.0000000000
## 210    jul tue           X  6.0000000000
## 211    aug sun           X  2.0000000000
## 212    aug sun           X  2.0000000000
## 213    aug wed           X  8.0000000000
## 214    jul sun           X  8.0000000000
```

```
## 215    sep sat           X  1.0000000000
## 216    aug sat           X  8.0000000000
## 217    aug mon           X  2.0000000000
## 218    aug sun           X  3.0000000000
## 219    aug sat           X  1.0000000000
## 220    aug sun           X  2.0000000000
## 221    aug mon           X  8.0000000000
## 222    aug sat           X  2.0000000000
## 223    sep fri           X  1.0000000000
## 224    aug mon           X  8.0000000000
## 225    apr mon           X  6.0000000000
## 226    sep fri           X  2.0000000000
## 227    aug wed           X  4.0000000000
## 228    aug fri           X  1.0000000000
## 229    aug wed           X  1.0000000000
## 230    aug sat           X  8.0000000000
## 231    aug sat           X  7.0000000000
## 232    sep sun           X  1.0000000000
## 233    feb tue           X  6.0000000000
## 234    feb tue           X  6.0000000000
## 235    feb sat           X  2.0000000000
## 236    mar mon           X  6.0000000000
## 237    mar wed           X  3.0000000000
## 238    mar thu           X  6.0000000000
## 239    apr sun           X  6.0000000000
## 240    may fri           X  4.0000000000
## 241    jun mon           X  8.0000000000
## 242    jun sat           X  9.0000000000
## 243    jun thu           X  4.0000000000
## 244    jun thu           X  2.0000000000
## 245    jul thu           X  4.0000000000
## 246    jul sun           X  4.0000000000
## 247    jul sun           X  7.0000000000
## 248    jul mon           X  7.0000000000
## 249    jul thu           X  9.0000000000
## 250    aug sun           X  3.0000000000
## 251    aug sun           X  2.0000000000
## 252    aug mon           X  2.0000000000
## 253    aug tue           X  5.0000000000
## 254    aug tue           X  5.0000000000
## 255    aug tue           X  4.0000000000
## 256    aug fri           X  1.0000000000
## 257    aug sat           X  6.0000000000
## 258    aug mon           X  4.0000000000
## 259    aug tue           X  3.0000000000
## 260    aug tue           X  6.0000000000
## 261    aug tue           X  7.0000000000
## 262    aug wed           X  2.0000000000
## 263    aug wed           X  4.0000000000
## 264    aug thu           X  1.0000000000
## 265    aug fri           X  5.0000000000
## 266    aug fri           X  6.0000000000
## 267    aug sun           X  4.0000000000
## 268    aug sun           X  2.0000000000
```

```
## 269    aug sun           X  7.0000000000
## 270    jul tue           Y  9.0000000000
## 271    sep tue           Y  4.0000000000
## 272    sep mon           Y  5.0000000000
## 273    aug wed           Y  2.0000000000
## 274    aug fri           Y  6.0000000000
## 275    jul sat           Y  2.0000000000
## 276    aug wed           Y  5.0000000000
## 277    aug thu           Y  5.0000000000
## 278    mar mon           Y  4.0000000000
## 279    sep tue           Y  3.0000000000
## 280    aug tue           Y  2.0000000000
## 281    sep thu           Y  6.0000000000
## 282    jun fri           Y  5.0000000000
## 283    jul sun           Y  9.0000000000
## 284    jul sat           Y  4.0000000000
## 285    sep fri           Y  4.0000000000
## 286    sep sat           Y  5.0000000000
## 287    aug sun           Y  4.0000000000
## 288    sep sat           Y  4.0000000000
## 289    aug wed           Y  2.0000000000
## 290    aug wed           Y  4.0000000000
## 291    sep fri           Y  4.0000000000
## 292    mar mon           Y  4.0000000000
## 293    aug thu           Y  4.0000000000
## 294    mar sat           Y  3.0000000000
## 295    sep sat           Y  6.0000000000
## 296    sep sun           Y  5.0000000000
## 297    mar thu           Y  5.0000000000
## 298    aug wed           Y  5.0000000000
## 299    aug wed           Y  5.0000000000
## 300    mar fri           Y  5.0000000000
## 301    aug thu           Y  6.0000000000
## 302    sep wed           Y  4.0000000000
## 303    aug wed           Y  6.0000000000
## 304    aug sun           Y  4.0000000000
## 305    sep mon           Y  4.0000000000
## 306    aug sat           Y  4.0000000000
## 307    aug sat           Y  4.0000000000
## 308    apr thu           Y  5.0000000000
## 309    aug sun           Y  5.0000000000
## 310    sep wed           Y  5.0000000000
## 311    aug tue           Y  6.0000000000
## 312    sep sun           Y  3.0000000000
## 313    oct mon           Y  6.0000000000
## 314    feb sun           Y  4.0000000000
## 315    oct mon           Y  4.0000000000
## 316    aug fri           Y  6.0000000000
## 317    sep tue           Y  5.0000000000
## 318    mar sun           Y  6.0000000000
## 319    sep mon           Y  5.0000000000
## 320    mar sat           Y  4.0000000000
## 321    mar sun           Y  4.0000000000
## 322    mar fri           Y  5.0000000000
```

```
## 323    aug thu           Y  5.0000000000
## 324    aug tue           Y  2.0000000000
## 325    sep wed           Y  5.0000000000
## 326    aug tue           Y  2.0000000000
## 327    aug fri           Y  5.0000000000
## 328    apr thu           Y  5.0000000000
## 329    sep thu           Y  5.0000000000
## 330    sep tue           Y  4.0000000000
## 331    sep mon           Y  4.0000000000
## 332    sep tue           Y  5.0000000000
## 333    mar sun           Y  5.0000000000
## 334    feb sun           Y  4.0000000000
## 335    oct wed           Y  6.0000000000
## 336    mar sat           Y  6.0000000000
## 337    sep thu           Y  5.0000000000
## 338    aug sat           Y  2.0000000000
## 339    sep tue           Y  5.0000000000
## 340    sep fri           Y  5.0000000000
## 341    sep thu           Y  3.0000000000
## 342    oct sat           Y  4.0000000000
## 343    aug sat           Y  4.0000000000
## 344    sep fri           Y  4.0000000000
## 345    mar mon           Y  3.0000000000
## 346    mar sat           Y  4.0000000000
## 347    mar sat           Y  4.0000000000
## 348    sep sun           Y  4.0000000000
## 349    sep mon           Y  3.0000000000
## 350    sep wed           Y  5.0000000000
## 351    mar mon           Y  5.0000000000
## 352    aug sun           Y  6.0000000000
## 353    sep fri           Y  4.0000000000
## 354    mar mon           Y  3.0000000000
## 355    jul fri           Y  2.0000000000
## 356    sep wed           Y  4.0000000000
## 357    sep sun           Y  4.0000000000
## 358    oct mon           Y  5.0000000000
## 359    aug sat           Y  6.0000000000
## 360    sep sun           Y  6.0000000000
## 361    aug sat           Y  6.0000000000
## 362    sep wed           Y  4.0000000000
## 363    sep sun           Y  5.0000000000
## 364    sep tue           Y  4.0000000000
## 365    sep tue           Y  4.0000000000
## 366    sep sat           Y  5.0000000000
## 367    aug sun           Y  6.0000000000
## 368    sep sat           Y  2.0000000000
## 369    sep tue           Y  2.0000000000
## 370    sep sat           Y  5.0000000000
## 371    aug sun           Y  4.0000000000
## 372    aug sun           Y  4.0000000000
## 373    aug sun           Y  4.0000000000
## 374    aug wed           Y  4.0000000000
## 375    aug wed           Y  4.0000000000
## 376    aug wed           Y  5.0000000000
```

```
## 377    aug wed           Y  5.0000000000
## 378    aug wed           Y  5.0000000000
## 379    aug thu           Y  4.0000000000
## 380    aug thu           Y  3.0000000000
## 381    aug sat           Y  6.0000000000
## 382    aug sat           Y  3.0000000000
## 383    aug sat           Y  4.0000000000
## 384    aug mon           Y  4.0000000000
## 385    aug fri           Y  4.0000000000
## 386    aug fri           Y  4.0000000000
## 387    aug fri           Y  3.0000000000
## 388    aug fri           Y  4.0000000000
## 389    aug tue           Y  4.0000000000
## 390    aug tue           Y  5.0000000000
## 391    aug tue           Y  4.0000000000
## 392    aug tue           Y  2.0000000000
## 393    aug tue           Y  6.0000000000
## 394    aug tue           Y  5.0000000000
## 395    dec sun           Y  6.0000000000
## 396    dec wed           Y  6.0000000000
## 397    dec thu           Y  6.0000000000
## 398    dec mon           Y  4.0000000000
## 399    dec mon           Y  4.0000000000
## 400    dec mon           Y  4.0000000000
## 401    dec mon           Y  4.0000000000
## 402    dec fri           Y  6.0000000000
## 403    dec tue           Y  5.0000000000
## 404    feb wed           Y  4.0000000000
## 405    feb fri           Y  4.0000000000
## 406    jul sat           Y  4.0000000000
## 407    jul fri           Y  5.0000000000
## 408    jul tue           Y  6.0000000000
## 409    jul tue           Y  6.0000000000
## 410    jun sun           Y  4.0000000000
## 411    jun mon           Y  5.0000000000
## 412    sep sun           Y  4.0000000000
## 413    sep sun           Y  4.0000000000
## 414    sep sun           Y  3.0000000000
## 415    sep wed           Y  4.0000000000
## 416    sep thu           Y  4.0000000000
## 417    sep thu           Y  4.0000000000
## 418    sep thu           Y  3.0000000000
## 419    sep thu           Y  4.0000000000
## 420    sep thu           Y  5.0000000000
## 421    sep thu           Y  5.0000000000
## 422    sep thu           Y  5.0000000000
## 423    sep sat           Y  3.0000000000
## 424    sep sat           Y  3.0000000000
## 425    sep sat           Y  4.0000000000
## 426    sep sat           Y  4.0000000000
## 427    sep mon           Y  4.0000000000
## 428    sep mon           Y  3.0000000000
## 429    sep mon           Y  6.0000000000
## 430    sep mon           Y  4.0000000000
```

```
## 431    sep mon           Y  5.0000000000
## 432    sep mon           Y  6.0000000000
## 433    sep mon           Y  3.0000000000
## 434    sep mon           Y  2.0000000000
## 435    sep mon           Y  4.0000000000
## 436    sep fri           Y  4.0000000000
## 437    sep fri           Y  4.0000000000
## 438    sep fri           Y  4.0000000000
## 439    sep fri           Y  4.0000000000
## 440    sep fri           Y  4.0000000000
## 441    sep fri           Y  4.0000000000
## 442    sep fri           Y  4.0000000000
## 443    sep fri           Y  4.0000000000
## 444    sep fri           Y  4.0000000000
## 445    sep fri           Y  5.0000000000
## 446    sep fri           Y  3.0000000000
## 447    sep fri           Y  4.0000000000
## 448    sep tue           Y  3.0000000000
## 449    sep tue           Y  5.0000000000
## 450    sep tue           Y  5.0000000000
## 451    sep tue           Y  5.0000000000
## 452    sep sat           Y  5.0000000000
## 453    sep sun           Y  4.0000000000
## 454    sep fri           Y  5.0000000000
## 455    sep sat           Y  5.0000000000
## 456    aug sat           Y  2.0000000000
## 457    jul wed           Y  4.0000000000
## 458    aug thu           Y  6.0000000000
## 459    aug wed           Y  6.0000000000
## 460    aug thu           Y  6.0000000000
## 461    aug sat           Y  4.0000000000
## 462    aug sun           Y  4.0000000000
## 463    sep sun           Y  4.0000000000
## 464    aug fri           Y  4.0000000000
## 465    feb mon           Y  4.0000000000
## 466    sep fri           Y  6.0000000000
## 467    sep sun           Y  3.0000000000
## 468    feb sun           Y  5.0000000000
## 469    sep sun           Y  3.0000000000
## 470    aug sun           Y  6.0000000000
## 471    jun wed           Y  5.0000000000
## 472    sep thu           Y  4.0000000000
## 473    sep wed           Y  4.0000000000
## 474    sep sat           Y  5.0000000000
## 475    sep fri           Y  3.0000000000
## 476    feb fri           Y  4.0000000000
## 477    jul mon           Y  4.0000000000
## 478    aug thu           Y  6.0000000000
## 479    jul tue           Y  3.0000000000
## 480    aug sun           Y  4.0000000000
## 481    aug sun           Y  5.0000000000
## 482    aug wed           Y  8.0000000000
## 483    jul sun           Y  6.0000000000
## 484    sep sat           Y  3.0000000000
```

```
## 485    aug sat           Y  6.0000000000
## 486    aug mon           Y  4.0000000000
## 487    aug sun           Y  4.0000000000
## 488    aug sat           Y  3.0000000000
## 489    aug sun           Y  4.0000000000
## 490    aug mon           Y  6.0000000000
## 491    aug sat           Y  5.0000000000
## 492    sep fri           Y  3.0000000000
## 493    aug mon           Y  6.0000000000
## 494    apr mon           Y  5.0000000000
## 495    sep fri           Y  5.0000000000
## 496    aug wed           Y  5.0000000000
## 497    aug fri           Y  4.0000000000
## 498    aug wed           Y  4.0000000000
## 499    aug sat           Y  6.0000000000
## 500    aug sat           Y  4.0000000000
## 501    sep sun           Y  4.0000000000
## 502    feb tue           Y  5.0000000000
## 503    feb tue           Y  4.0000000000
## 504    feb sat           Y  2.0000000000
## 505    mar mon           Y  5.0000000000
## 506    mar wed           Y  4.0000000000
## 507    mar thu           Y  5.0000000000
## 508    apr sun           Y  3.0000000000
## 509    may fri           Y  3.0000000000
## 510    jun mon           Y  3.0000000000
## 511    jun sat           Y  4.0000000000
## 512    jun thu           Y  3.0000000000
## 513    jun thu           Y  5.0000000000
## 514    jul thu           Y  3.0000000000
## 515    jul sun           Y  3.0000000000
## 516    jul sun           Y  4.0000000000
## 517    jul mon           Y  4.0000000000
## 518    jul thu           Y  9.0000000000
## 519    aug sun           Y  4.0000000000
## 520    aug sun           Y  5.0000000000
## 521    aug mon           Y  4.0000000000
## 522    aug tue           Y  4.0000000000
## 523    aug tue           Y  4.0000000000
## 524    aug tue           Y  4.0000000000
## 525    aug fri           Y  3.0000000000
## 526    aug sat           Y  6.0000000000
## 527    aug mon           Y  5.0000000000
## 528    aug tue           Y  4.0000000000
## 529    aug tue           Y  5.0000000000
## 530    aug tue           Y  5.0000000000
## 531    aug wed           Y  4.0000000000
## 532    aug wed           Y  3.0000000000
## 533    aug thu           Y  2.0000000000
## 534    aug fri           Y  4.0000000000
## 535    aug fri           Y  5.0000000000
## 536    aug sun           Y  3.0000000000
## 537    aug sun           Y  4.0000000000
## 538    aug sun           Y  4.0000000000
```

```
## 539    jul tue        FFMC -1.4078948383
## 540    sep tue        FFMC -0.0084041477
## 541    sep mon        FFMC -0.0353174302
## 542    aug wed        FFMC  1.2026935653
## 543    aug fri        FFMC -0.2506236903
## 544    jul sat        FFMC -0.2775369728
## 545    aug wed        FFMC  1.2026935653
## 546    aug thu        FFMC  1.1219537178
## 547    mar mon        FFMC -0.2506236903
## 548    sep tue        FFMC -1.7846807934
## 549    aug tue        FFMC  1.0143005877
## 550    sep thu        FFMC  0.7182544801
## 551    jun fri        FFMC  0.3952950900
## 552    jul sun        FFMC -0.2506236903
## 553    jul sat        FFMC -0.2506236903
## 554    sep fri        FFMC  0.8797341752
## 555    sep sat        FFMC  0.6375146326
## 556    aug sun        FFMC  1.0143005877
## 557    sep sat        FFMC  0.6375146326
## 558    aug wed        FFMC  0.2876419599
## 559    aug wed        FFMC  0.2876419599
## 560    sep fri        FFMC  0.3683818075
## 561    mar mon        FFMC -0.2506236903
## 562    aug thu        FFMC  1.1219537178
## 563    mar sat        FFMC -0.1160572777
## 564    sep sat        FFMC  0.3952950900
## 565    sep sun        FFMC -0.3582768203
## 566    mar thu        FFMC -1.6501143809
## 567    aug wed        FFMC  0.2876419599
## 568    aug wed        FFMC  1.3372599779
## 569    mar fri        FFMC  0.0454224173
## 570    aug thu        FFMC  1.1219537178
## 571    sep wed        FFMC  0.5029482200
## 572    aug wed        FFMC -1.4617214033
## 573    aug sun        FFMC  0.0992489823
## 574    sep mon        FFMC -0.0353174302
## 575    aug sat        FFMC -0.2237104078
## 576    aug sat        FFMC -0.2237104078
## 577    apr thu        FFMC -2.5651659863
## 578    aug sun        FFMC -0.2237104078
## 579    sep wed        FFMC -0.2506236903
## 580    aug tue        FFMC -0.6004963629
## 581    sep sun        FFMC  0.3683818075
## 582    oct mon        FFMC -1.6501143809
## 583    feb sun        FFMC -1.1387620132
## 584    oct mon        FFMC  0.1799888299
## 585    aug fri        FFMC  0.7720810451
## 586    sep tue        FFMC -0.0084041477
## 587    mar sun        FFMC -0.4659299504
## 588    sep mon        FFMC -0.0353174302
## 589    mar sat        FFMC -0.0622307127
## 590    mar sun        FFMC -0.0891439952
## 591    mar fri        FFMC  0.0454224173
## 592    aug thu        FFMC  1.1219537178
```

```
## 593    aug tue        FFMC  1.0143005877
## 594    sep wed        FFMC  0.5029482200
## 595    aug tue        FFMC  1.0143005877
## 596    aug fri        FFMC  0.7720810451
## 597    apr thu        FFMC -2.5651659863
## 598    sep thu        FFMC  0.5029482200
## 599    sep tue        FFMC -0.0084041477
## 600    sep mon        FFMC -7.4095568383
## 601    sep tue        FFMC -0.0084041477
## 602    mar sun        FFMC -0.2506236903
## 603    feb sun        FFMC -1.9192472060
## 604    oct wed        FFMC  0.0992489823
## 605    mar sat        FFMC -0.1160572777
## 606    sep thu        FFMC  0.5029482200
## 607    aug sat        FFMC  0.6644279151
## 608    sep tue        FFMC -0.0084041477
## 609    sep fri        FFMC  0.3683818075
## 610    sep thu        FFMC  0.7182544801
## 611    oct sat        FFMC -0.1160572777
## 612    aug sat        FFMC  0.6644279151
## 613    sep fri        FFMC  0.8797341752
## 614    mar mon        FFMC -0.9234557531
## 615    mar sat        FFMC  0.1799888299
## 616    mar sat        FFMC  0.1799888299
## 617    sep sun        FFMC  0.3683818075
## 618    sep mon        FFMC -0.6543229280
## 619    sep wed        FFMC  0.5029482200
## 620    mar mon        FFMC -0.2506236903
## 621    aug sun        FFMC -0.2237104078
## 622    sep fri        FFMC  0.6106013501
## 623    mar mon        FFMC -0.9234557531
## 624    jul fri        FFMC -0.7350627755
## 625    sep wed        FFMC -0.2506236903
## 626    sep sun        FFMC  0.6644279151
## 627    oct mon        FFMC  0.1799888299
## 628    aug sat        FFMC  0.3145552424
## 629    sep sun        FFMC  0.6644279151
## 630    aug sat        FFMC  0.3145552424
## 631    sep wed        FFMC  0.5029482200
## 632    sep sun        FFMC  0.6644279151
## 633    sep tue        FFMC -0.0084041477
## 634    sep tue        FFMC -1.7846807934
## 635    sep sat        FFMC  0.3952950900
## 636    aug sun        FFMC  0.0992489823
## 637    sep sat        FFMC  0.3952950900
## 638    sep tue        FFMC -0.0084041477
## 639    sep sat        FFMC  0.3952950900
## 640    aug sun        FFMC  0.8528208927
## 641    aug sun        FFMC  0.2069021124
## 642    aug sun        FFMC  0.2069021124
## 643    aug wed        FFMC  0.3145552424
## 644    aug wed        FFMC  0.5567747850
## 645    aug wed        FFMC  0.5567747850
## 646    aug wed        FFMC  0.5567747850
```

```
## 647    aug wed        FFMC  0.5567747850
## 648    aug thu        FFMC  0.2338153949
## 649    aug thu        FFMC  0.1530755474
## 650    aug sat        FFMC  0.8528208927
## 651    aug sat        FFMC  0.8528208927
## 652    aug sat        FFMC  0.2069021124
## 653    aug mon        FFMC  0.6913411976
## 654    aug fri        FFMC  0.1530755474
## 655    aug fri        FFMC  0.1530755474
## 656    aug fri        FFMC  0.0185091348
## 657    aug fri        FFMC  0.8797341752
## 658    aug tue        FFMC  0.7182544801
## 659    aug tue        FFMC  0.8797341752
## 660    aug tue        FFMC  0.2876419599
## 661    aug tue        FFMC  0.2876419599
## 662    aug tue        FFMC  0.2876419599
## 663    aug tue        FFMC  0.2876419599
## 664    dec sun        FFMC -1.7846807934
## 665    dec wed        FFMC -1.8923339235
## 666    dec thu        FFMC -1.7308542284
## 667    dec mon        FFMC -1.5155479683
## 668    dec mon        FFMC -1.5155479683
## 669    dec mon        FFMC -1.5155479683
## 670    dec mon        FFMC -1.5155479683
## 671    dec fri        FFMC -1.7039409459
## 672    dec tue        FFMC -1.5155479683
## 673    feb wed        FFMC -1.1118487307
## 674    feb fri        FFMC -1.5693745333
## 675    jul sat        FFMC  0.1530755474
## 676    jul fri        FFMC  0.1530755474
## 677    jul tue        FFMC  0.5567747850
## 678    jul tue        FFMC  0.3414685249
## 679    jun sun        FFMC -0.1698838428
## 680    jun mon        FFMC -0.1698838428
## 681    sep sun        FFMC -0.3851901029
## 682    sep sun        FFMC -0.3851901029
## 683    sep sun        FFMC  0.3683818075
## 684    sep wed        FFMC  0.4222083725
## 685    sep thu        FFMC  0.3683818075
## 686    sep thu        FFMC  0.4760349375
## 687    sep thu        FFMC  0.4760349375
## 688    sep thu        FFMC  0.4760349375
## 689    sep thu        FFMC  0.4760349375
## 690    sep thu        FFMC -0.0891439952
## 691    sep thu        FFMC -0.7888893405
## 692    sep sat        FFMC  0.3145552424
## 693    sep sat        FFMC  0.3145552424
## 694    sep sat        FFMC  0.0454224173
## 695    sep sat        FFMC  0.0454224173
## 696    sep mon        FFMC  0.2876419599
## 697    sep mon        FFMC  0.1530755474
## 698    sep mon        FFMC  0.1530755474
## 699    sep mon        FFMC  0.1530755474
## 700    sep mon        FFMC  0.1530755474
```

```
## 701    sep mon        FFMC  0.1261622649
## 702    sep mon        FFMC  0.1261622649
## 703    sep mon        FFMC  0.1261622649
## 704    sep mon        FFMC  0.1261622649
## 705    sep fri        FFMC  0.2876419599
## 706    sep fri        FFMC  0.2876419599
## 707    sep fri        FFMC  0.2876419599
## 708    sep fri        FFMC  0.2876419599
## 709    sep fri        FFMC  0.2876419599
## 710    sep fri        FFMC  0.2876419599
## 711    sep fri        FFMC  0.2876419599
## 712    sep fri        FFMC  0.2876419599
## 713    sep fri        FFMC  0.3952950900
## 714    sep fri        FFMC  0.3952950900
## 715    sep fri        FFMC  0.3952950900
## 716    sep fri        FFMC -0.7619760580
## 717    sep tue        FFMC  0.2338153949
## 718    sep tue        FFMC  0.2338153949
## 719    sep tue        FFMC  0.2338153949
## 720    sep tue        FFMC  0.0185091348
## 721    sep sat        FFMC  0.0454224173
## 722    sep sun        FFMC -0.0084041477
## 723    sep fri        FFMC -0.1967971253
## 724    sep sat        FFMC  0.0454224173
## 725    aug sat        FFMC  0.7182544801
## 726    jul wed        FFMC  0.7182544801
## 727    aug thu        FFMC -0.0891439952
## 728    aug wed        FFMC  1.1219537178
## 729    aug thu        FFMC  0.1530755474
## 730    aug sat        FFMC  0.1530755474
## 731    aug sun        FFMC  0.1530755474
## 732    sep sun        FFMC -0.1429705603
## 733    aug fri        FFMC  1.0143005877
## 734    feb mon        FFMC -1.7039409459
## 735    sep fri        FFMC  0.0185091348
## 736    sep sun        FFMC -0.0084041477
## 737    feb sun        FFMC -1.6232010984
## 738    sep sun        FFMC -0.1429705603
## 739    aug sun        FFMC  0.1530755474
## 740    jun wed        FFMC  0.6106013501
## 741    sep thu        FFMC  0.0185091348
## 742    sep wed        FFMC -0.8427159055
## 743    sep sat        FFMC -1.0580221656
## 744    sep fri        FFMC -0.1967971253
## 745    feb fri        FFMC -1.7308542284
## 746    jul mon        FFMC  0.3414685249
## 747    aug thu        FFMC  1.0143005877
## 748    jul tue        FFMC  0.4491216550
## 749    aug sun        FFMC  0.2607286774
## 750    aug sun        FFMC  0.1530755474
## 751    aug wed        FFMC  0.1799888299
## 752    jul sun        FFMC -0.5735830804
## 753    sep sat        FFMC  0.0454224173
## 754    aug sat        FFMC  0.7182544801
```

```
## 755    aug mon        FFMC  0.2876419599
## 756    aug sun        FFMC  0.1530755474
## 757    aug sat        FFMC  0.2876419599
## 758    aug sun        FFMC  0.6913411976
## 759    aug mon        FFMC  0.2876419599
## 760    aug sat        FFMC  0.7182544801
## 761    sep fri        FFMC  0.0185091348
## 762    aug mon        FFMC  0.2876419599
## 763    apr mon        FFMC -0.8427159055
## 764    sep fri        FFMC -0.1967971253
## 765    aug wed        FFMC  1.1219537178
## 766    aug fri        FFMC -0.1429705603
## 767    aug wed        FFMC  0.1799888299
## 768    aug sat        FFMC  0.7182544801
## 769    aug sat        FFMC  0.1530755474
## 770    sep sun        FFMC -0.0084041477
## 771    feb tue        FFMC -4.2876160670
## 772    feb tue        FFMC -4.2876160670
## 773    feb sat        FFMC -3.1034316365
## 774    mar mon        FFMC -1.0311088831
## 775    mar wed        FFMC -0.2237104078
## 776    mar thu        FFMC  0.0723356998
## 777    apr sun        FFMC -0.0084041477
## 778    may fri        FFMC -0.3851901029
## 779    jun mon        FFMC -0.7619760580
## 780    jun sat        FFMC -0.1429705603
## 781    jun thu        FFMC  0.5298615025
## 782    jun thu        FFMC  0.7182544801
## 783    jul thu        FFMC  0.6644279151
## 784    jul sun        FFMC  0.7182544801
## 785    jul sun        FFMC  0.7182544801
## 786    jul mon        FFMC -0.4928432329
## 787    jul thu        FFMC  0.5836880675
## 788    aug sun        FFMC  1.0412138702
## 789    aug sun        FFMC  1.0412138702
## 790    aug mon        FFMC  1.0681271527
## 791    aug tue        FFMC  1.0950404353
## 792    aug tue        FFMC  1.0950404353
## 793    aug tue        FFMC  1.0950404353
## 794    aug fri        FFMC  1.3103466953
## 795    aug sat        FFMC  1.3372599779
## 796    aug mon        FFMC  1.3910865429
## 797    aug tue        FFMC  1.3641732604
## 798    aug tue        FFMC  1.3641732604
## 799    aug tue        FFMC  1.3641732604
## 800    aug wed        FFMC  0.9335607402
## 801    aug wed        FFMC  0.9335607402
## 802    aug thu        FFMC -0.0084041477
## 803    aug fri        FFMC -0.0084041477
## 804    aug fri        FFMC -0.0084041477
## 805    aug sun        FFMC -2.5382527037
## 806    aug sun        FFMC -2.5382527037
## 807    aug sun        FFMC -2.5382527037
## 808    jul tue         DMC -1.0710782994
```

```
## 809    sep tue         DMC  0.2430235288
## 810    sep mon         DMC  0.1944729687
## 811    aug wed         DMC -0.2360086647
## 812    aug fri         DMC -0.1049221523
## 813    jul sat         DMC -1.0225277393
## 814    aug wed         DMC -0.2360086647
## 815    aug thu         DMC  0.2786272729
## 816    mar mon         DMC -1.2102565719
## 817    sep tue         DMC -0.6648719461
## 818    aug tue         DMC -0.1000670963
## 819    sep thu         DMC -0.5434955457
## 820    jun fri         DMC -0.9399917870
## 821    jul sun         DMC -0.7425528424
## 822    jul sat         DMC -1.0241460913
## 823    sep fri         DMC -0.4755247615
## 824    sep sat         DMC  0.5003414977
## 825    aug sun         DMC -0.1000670963
## 826    sep sat         DMC  0.5003414977
## 827    aug wed         DMC -0.0531348881
## 828    aug wed         DMC -0.0531348881
## 829    sep fri         DMC  0.0552946962
## 830    mar mon         DMC -1.2102565719
## 831    aug thu         DMC  0.2786272729
## 832    mar sat         DMC -1.0419479634
## 833    sep sat         DMC  0.1070819604
## 834    sep sun         DMC -0.3962255133
## 835    mar thu         DMC -1.5582022530
## 836    aug wed         DMC -0.0531348881
## 837    aug wed         DMC  0.2041830807
## 838    mar fri         DMC -1.0710782994
## 839    aug thu         DMC  0.2786272729
## 840    sep wed         DMC  0.3045209050
## 841    aug wed         DMC -0.3897521052
## 842    aug sun         DMC  0.4517909375
## 843    sep mon         DMC  0.1944729687
## 844    aug sat         DMC -0.2845592249
## 845    aug sat         DMC -0.2845592249
## 846    apr thu         DMC -1.7054722855
## 847    aug sun         DMC -0.2408637208
## 848    sep wed         DMC -0.5111285056
## 849    aug tue         DMC  0.5310901858
## 850    sep sun         DMC  0.1556325205
## 851    oct mon         DMC -1.3219228603
## 852    feb sun         DMC -1.6002794052
## 853    oct mon         DMC -1.0678415954
## 854    aug fri         DMC  0.3433613531
## 855    sep tue         DMC  0.2430235288
## 856    mar sun         DMC -1.0225277393
## 857    sep mon         DMC  0.1944729687
## 858    mar sat         DMC -1.1746528278
## 859    mar sun         DMC -1.1406674357
## 860    mar fri         DMC -1.0710782994
## 861    aug thu         DMC  0.2786272729
## 862    aug tue         DMC -0.1000670963
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## 863    sep wed         DMC  0.3045209050
## 864    aug tue         DMC -0.1000670963
## 865    aug fri         DMC  0.3433613531
## 866    apr thu         DMC -1.7054722855
## 867    sep thu         DMC  0.3643999292
## 868    sep tue         DMC  0.2430235288
## 869    sep mon         DMC -0.7069490983
## 870    sep tue         DMC  0.2430235288
## 871    mar sun         DMC -1.2442419640
## 872    feb sun         DMC -1.7119456935
## 873    oct wed         DMC -1.2393869080
## 874    mar sat         DMC -1.0419479634
## 875    sep thu         DMC  0.3643999292
## 876    aug sat         DMC  0.4032403773
## 877    sep tue         DMC  0.2430235288
## 878    sep fri         DMC  0.0552946962
## 879    sep thu         DMC -0.5434955457
## 880    oct sat         DMC -1.1455224917
## 881    aug sat         DMC  0.4032403773
## 882    sep fri         DMC -0.4755247615
## 883    mar mon         DMC -1.0079625712
## 884    mar sat         DMC -1.2733723001
## 885    mar sat         DMC -1.2733723001
## 886    sep sun         DMC  0.1556325205
## 887    sep mon         DMC -0.3670951772
## 888    sep wed         DMC  0.3045209050
## 889    mar mon         DMC -1.2102565719
## 890    aug sun         DMC -0.2408637208
## 891    sep fri         DMC  0.4323707134
## 892    mar mon         DMC -1.0079625712
## 893    jul fri         DMC  0.5796407459
## 894    sep wed         DMC -0.5111285056
## 895    sep sun         DMC  0.5634572259
## 896    oct mon         DMC -1.0678415954
## 897    aug sat         DMC -0.5289303777
## 898    sep sun         DMC  0.5634572259
## 899    aug sat         DMC -0.5289303777
## 900    sep wed         DMC  0.3045209050
## 901    sep sun         DMC  0.5634572259
## 902    sep tue         DMC  0.2430235288
## 903    sep tue         DMC -0.6648719461
## 904    sep sat         DMC  0.1070819604
## 905    aug sun         DMC  0.4517909375
## 906    sep sat         DMC  0.1070819604
## 907    sep tue         DMC  0.2430235288
## 908    sep sat         DMC  0.1070819604
## 909    aug sun         DMC  0.1265021844
## 910    aug sun         DMC  0.9809920432
## 911    aug sun         DMC  0.9809920432
## 912    aug wed         DMC -0.3703318812
## 913    aug wed         DMC  0.6929253863
## 914    aug wed         DMC  0.6929253863
## 915    aug wed         DMC  0.6929253863
## 916    aug wed         DMC  0.6929253863
```

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## 917    aug thu         DMC -0.0855019282
## 918    aug thu         DMC  0.3822018013
## 919    aug sat         DMC  0.0439662322
## 920    aug sat         DMC  0.0439662322
## 921    aug sat         DMC  0.9130212590
## 922    aug mon         DMC -0.2683757048
## 923    aug fri         DMC -0.0337146641
## 924    aug fri         DMC -0.0337146641
## 925    aug fri         DMC  0.4307523614
## 926    aug fri         DMC  0.8596156428
## 927    aug tue         DMC -0.1987865686
## 928    aug tue         DMC  0.2786272729
## 929    aug tue         DMC  0.6168628420
## 930    aug tue         DMC  0.6168628420
## 931    aug tue         DMC  0.6168628420
## 932    aug tue         DMC  0.6168628420
## 933    dec sun         DMC -1.4125505726
## 934    dec wed         DMC -1.4028404605
## 935    dec thu         DMC -1.4254973886
## 936    dec mon         DMC -1.4416809087
## 937    dec mon         DMC -1.4416809087
## 938    dec mon         DMC -1.4416809087
## 939    dec mon         DMC -1.4416809087
## 940    dec fri         DMC -1.4206423326
## 941    dec tue         DMC -1.4416809087
## 942    feb wed         DMC -1.7459310856
## 943    feb fri         DMC -1.7734430697
## 944    jul sat         DMC -0.1664195285
## 945    jul fri         DMC -0.2311536087
## 946    jul tue         DMC  1.0667646995
## 947    jul tue         DMC -0.4156457373
## 948    jun sun         DMC -0.4043172733
## 949    jun mon         DMC -0.3428198971
## 950    sep sun         DMC -0.4917082816
## 951    sep sun         DMC -0.4917082816
## 952    sep sun         DMC -0.1405258964
## 953    sep wed         DMC  0.0148358961
## 954    sep thu         DMC -0.2958876889
## 955    sep thu         DMC  0.0730965683
## 956    sep thu         DMC  0.0730965683
## 957    sep thu         DMC  0.0730965683
## 958    sep thu         DMC  0.0730965683
## 959    sep thu         DMC  0.3627815772
## 960    sep thu         DMC -0.9901606992
## 961    sep sat         DMC -0.1971682166
## 962    sep sat         DMC -0.1971682166
## 963    sep sat         DMC  0.1604875766
## 964    sep sat         DMC  0.1604875766
## 965    sep mon         DMC -0.4334476094
## 966    sep mon         DMC -0.0984487443
## 967    sep mon         DMC -0.0984487443
## 968    sep mon         DMC -0.0984487443
## 969    sep mon         DMC -0.0984487443
## 970    sep mon         DMC  0.2527336409
```

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## 971    sep mon         DMC  0.2527336409
## 972    sep mon         DMC  0.2527336409
## 973    sep mon         DMC  0.2527336409
## 974    sep fri         DMC -0.2505738328
## 975    sep fri         DMC -0.2505738328
## 976    sep fri         DMC -0.2505738328
## 977    sep fri         DMC -0.2505738328
## 978    sep fri         DMC -0.2505738328
## 979    sep fri         DMC -0.2505738328
## 980    sep fri         DMC -0.2505738328
## 981    sep fri         DMC -0.2505738328
## 982    sep fri         DMC  0.1216471284
## 983    sep fri         DMC  0.1216471284
## 984    sep fri         DMC  0.1216471284
## 985    sep fri         DMC -0.9594120111
## 986    sep tue         DMC -0.0450431281
## 987    sep tue         DMC -0.0450431281
## 988    sep tue         DMC -0.0450431281
## 989    sep tue         DMC  0.2883373850
## 990    sep sat         DMC -0.3266363770
## 991    sep sun         DMC  2.6187642725
## 992    sep fri         DMC  2.8404784973
## 993    sep sat         DMC -0.3266363770
## 994    aug sat         DMC  1.8872691662
## 995    jul wed         DMC -0.2133517367
## 996    aug thu         DMC  1.2884789242
## 997    aug wed         DMC  1.6704099975
## 998    aug thu         DMC  2.1672440631
## 999    aug sat         DMC  2.5783054724
## 1000   aug sun         DMC  1.0813298675
## 1001   sep sun         DMC -0.2877959289
## 1002   aug fri         DMC  1.8209167339
## 1003   feb mon         DMC -1.6989988775
## 1004   sep fri         DMC -0.3751869372
## 1005   sep sun         DMC  2.6187642725
## 1006   feb sun         DMC -1.7070906375
## 1007   sep sun         DMC -0.2877959289
## 1008   aug sun         DMC  1.0813298675
## 1009   jun wed         DMC -1.0516580754
## 1010   sep thu         DMC -0.4253558494
## 1011   sep wed         DMC -0.4803798175
## 1012   sep sat         DMC  2.8615170733
## 1013   sep fri         DMC  2.8404784973
## 1014   feb fri         DMC -1.8009550538
## 1015   jul mon         DMC -0.3622401211
## 1016   aug thu         DMC  1.7464725417
## 1017   jul tue         DMC  0.8029733226
## 1018   aug sun         DMC  1.4357489567
## 1019   aug sun         DMC  1.0813298675
## 1020   aug wed         DMC  1.2447834201
## 1021   jul sun         DMC  2.4051418078
## 1022   sep sat         DMC -0.3266363770
## 1023   aug sat         DMC  1.8872691662
## 1024   aug mon         DMC  1.4972463329
```

```
## 1025   aug sun         DMC  1.0813298675
## 1026   aug sat         DMC  1.0279242514
## 1027   aug sun         DMC  1.9520032464
## 1028   aug mon         DMC  1.4972463329
## 1029   aug sat         DMC  1.8872691662
## 1030   sep fri         DMC -0.3751869372
## 1031   aug mon         DMC  1.4972463329
## 1032   apr mon         DMC -1.4497726687
## 1033   sep fri         DMC  2.8404784973
## 1034   aug wed         DMC  1.6704099975
## 1035   aug fri         DMC  1.3321744284
## 1036   aug wed         DMC  1.2447834201
## 1037   aug sat         DMC  1.8872691662
## 1038   aug sat         DMC  2.5783054724
## 1039   sep sun         DMC  2.6187642725
## 1040   feb tue         DMC -1.7815348298
## 1041   feb tue         DMC -1.7815348298
## 1042   feb sat         DMC -1.7944816458
## 1043   mar mon         DMC -1.6083711652
## 1044   mar wed         DMC -1.5533471970
## 1045   mar thu         DMC -1.5193618049
## 1046   apr sun         DMC -1.6164629252
## 1047   may fri         DMC -1.4416809087
## 1048   jun mon         DMC -0.2958876889
## 1049   jun sat         DMC -0.8639292428
## 1050   jun thu         DMC -0.1728929365
## 1051   jun thu         DMC  0.1167920724
## 1052   jul thu         DMC -0.4722880575
## 1053   jul sun         DMC -0.2133517367
## 1054   jul sun         DMC -0.2133517367
## 1055   jul mon         DMC -0.1712745845
## 1056   jul thu         DMC -0.0013476240
## 1057   aug sun         DMC  0.2559703449
## 1058   aug sun         DMC  0.2559703449
## 1059   aug mon         DMC  0.3401246491
## 1060   aug tue         DMC  0.4339890654
## 1061   aug tue         DMC  0.4339890654
## 1062   aug tue         DMC  0.4339890654
## 1063   aug fri         DMC  0.7042538503
## 1064   aug sat         DMC  0.8013549706
## 1065   aug mon         DMC  0.9874654512
## 1066   aug tue         DMC  1.0780931635
## 1067   aug tue         DMC  1.0780931635
## 1068   aug tue         DMC  1.0780931635
## 1069   aug wed         DMC  0.4032403773
## 1070   aug wed         DMC  0.4032403773
## 1071   aug thu         DMC  0.7884081546
## 1072   aug fri         DMC  0.8482871788
## 1073   aug fri         DMC  0.8482871788
## 1074   aug sun         DMC -0.9351367310
## 1075   aug sun         DMC -0.9351367310
## 1076   aug sun         DMC -0.9351367310
## 1077   jul tue          DC -1.1159993929
## 1078   sep tue          DC  0.5307425565
```

```
## 1079   sep mon          DC  0.5042522456
## 1080   aug wed          DC -0.2478988768
## 1081   aug fri          DC -0.1762447572
## 1082   jul sat          DC -1.1902591169
## 1083   aug wed          DC -0.2478988768
## 1084   aug thu          DC  0.0365462647
## 1085   mar mon          DC -2.1009178374
## 1086   sep tue          DC  0.4408492064
## 1087   aug tue          DC  0.3331508933
## 1088   sep thu          DC  0.4986067695
## 1089   jun fri          DC -0.5953127902
## 1090   jul sun          DC -0.9344756232
## 1091   jul sat          DC -0.6352653903
## 1092   sep fri          DC  0.5294397544
## 1093   sep sat          DC  0.6558115653
## 1094   aug sun          DC  0.3331508933
## 1095   sep sat          DC  0.6558115653
## 1096   aug wed          DC  0.3635496107
## 1097   aug wed          DC  0.3635496107
## 1098   sep fri          DC  0.4239127782
## 1099   mar mon          DC -2.1009178374
## 1100   aug thu          DC  0.0365462647
## 1101   mar sat          DC -2.0409889373
## 1102   sep sat          DC  0.4517058912
## 1103   sep sun          DC  0.5819861088
## 1104   mar thu          DC -2.2381463332
## 1105   aug wed          DC  0.3635496107
## 1106   aug wed          DC  0.0005020712
## 1107   mar fri          DC -2.0522798895
## 1108   aug thu          DC  0.0365462647
## 1109   sep wed          DC  0.5611412739
## 1110   aug wed          DC  0.1703006214
## 1111   aug sun          DC  0.1346906953
## 1112   sep mon          DC  0.5042522456
## 1113   aug sat          DC  0.2337036606
## 1114   aug sat          DC  0.2337036606
## 1115   apr thu          DC -2.2372777984
## 1116   aug sun          DC  0.2641023780
## 1117   sep wed          DC  0.7179118024
## 1118   aug tue          DC  0.1915797236
## 1119   sep sun          DC  0.4790647369
## 1120   oct mon          DC  0.4074106173
## 1121   feb sun          DC -2.2672422484
## 1122   oct mon          DC  0.5459419152
## 1123   aug fri          DC  0.0708533887
## 1124   sep tue          DC  0.5307425565
## 1125   mar sun          DC -2.0331721243
## 1126   sep mon          DC  0.5042522456
## 1127   mar sat          DC -2.0887583504
## 1128   mar sun          DC -2.0757303287
## 1129   mar fri          DC -2.0522798895
## 1130   aug thu          DC  0.0365462647
## 1131   aug tue          DC  0.3331508933
## 1132   sep wed          DC  0.5611412739
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## 1133   aug tue          DC  0.3331508933
## 1134   aug fri          DC  0.0708533887
## 1135   apr thu          DC -2.2372777984
## 1136   sep thu          DC  0.5906714566
## 1137   sep tue          DC  0.5307425565
## 1138   sep mon          DC  0.4121875586
## 1139   sep tue          DC  0.5307425565
## 1140   mar sun          DC -2.1135115917
## 1141   feb sun          DC -2.3375935659
## 1142   oct wed          DC  0.4491002869
## 1143   mar sat          DC -2.0409889373
## 1144   sep thu          DC  0.5906714566
## 1145   aug sat          DC  0.1034234431
## 1146   sep tue          DC  0.5307425565
## 1147   sep fri          DC  0.4239127782
## 1148   sep thu          DC  0.4986067695
## 1149   oct sat          DC  0.5059893152
## 1150   aug sat          DC  0.1034234431
## 1151   sep fri          DC  0.5294397544
## 1152   mar mon          DC -2.0262238460
## 1153   mar sat          DC -2.1261053461
## 1154   mar sat          DC -2.1261053461
## 1155   sep sun          DC  0.4790647369
## 1156   sep mon          DC  0.6058708153
## 1157   sep wed          DC  0.5611412739
## 1158   mar mon          DC -2.1009178374
## 1159   aug sun          DC  0.2641023780
## 1160   sep fri          DC  0.6232415110
## 1161   mar mon          DC -2.0262238460
## 1162   jul fri          DC -1.1311987516
## 1163   sep wed          DC  0.7179118024
## 1164   sep sun          DC  0.6870788176
## 1165   oct mon          DC  0.5459419152
## 1166   aug sat          DC -0.3890357792
## 1167   sep sun          DC  0.6870788176
## 1168   aug sat          DC -0.3890357792
## 1169   sep wed          DC  0.5611412739
## 1170   sep sun          DC  0.6870788176
## 1171   sep tue          DC  0.5307425565
## 1172   sep tue          DC  0.4408492064
## 1173   sep sat          DC  0.4517058912
## 1174   aug sun          DC  0.1346906953
## 1175   sep sat          DC  0.4517058912
## 1176   sep tue          DC  0.5307425565
## 1177   sep sat          DC  0.4517058912
## 1178   aug sun          DC  0.0847499452
## 1179   aug sun          DC  0.5659182153
## 1180   aug sun          DC  0.5659182153
## 1181   aug wed          DC -0.2900228138
## 1182   aug wed          DC  0.4182673021
## 1183   aug wed          DC  0.4182673021
## 1184   aug wed          DC  0.4182673021
## 1185   aug wed          DC  0.4182673021
## 1186   aug thu          DC -0.0212112984
```

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## 1187   aug thu          DC  0.2228469758
## 1188   aug sat          DC  0.0465344147
## 1189   aug sat          DC  0.0465344147
## 1190   aug sat          DC  0.5294397544
## 1191   aug mon          DC -0.1232641354
## 1192   aug fri          DC  0.0113587560
## 1193   aug fri          DC  0.0113587560
## 1194   aug fri          DC  0.2549827628
## 1195   aug fri          DC  0.4951326304
## 1196   aug tue          DC -0.0872199419
## 1197   aug tue          DC  0.1594439366
## 1198   aug tue          DC  0.3813545738
## 1199   aug tue          DC  0.3813545738
## 1200   aug tue          DC  0.3813545738
## 1201   aug tue          DC  0.3813545738
## 1202   dec sun          DC -0.9418581688
## 1203   dec wed          DC -0.9370812275
## 1204   dec thu          DC -0.9483721797
## 1205   dec mon          DC -0.9583603297
## 1206   dec mon          DC -0.9583603297
## 1207   dec mon          DC -0.9583603297
## 1208   dec mon          DC -0.9583603297
## 1209   dec fri          DC -0.9457665754
## 1210   dec tue          DC -0.9583603297
## 1211   feb wed          DC -2.3957853964
## 1212   feb fri          DC -2.4083791507
## 1213   jul sat          DC -0.4146575553
## 1214   jul fri          DC -0.4520045510
## 1215   jul tue          DC -0.6061694750
## 1216   jul tue          DC -0.5623084685
## 1217   jun sun          DC -1.2141438235
## 1218   jun mon          DC -1.1824423039
## 1219   sep sun          DC  0.6249785805
## 1220   sep sun          DC  0.6249785805
## 1221   sep sun          DC  0.8151876981
## 1222   sep wed          DC  0.8976985025
## 1223   sep thu          DC  0.7339796959
## 1224   sep thu          DC  0.9254916156
## 1225   sep thu          DC  0.9254916156
## 1226   sep thu          DC  0.9254916156
## 1227   sep thu          DC  0.9254916156
## 1228   sep thu          DC  1.0961587006
## 1229   sep thu          DC  0.6796962719
## 1230   sep sat          DC  0.7865260503
## 1231   sep sat          DC  0.7865260503
## 1232   sep sat          DC  0.9767351678
## 1233   sep sat          DC  0.9767351678
## 1234   sep mon          DC  0.6545087632
## 1235   sep mon          DC  0.8408094742
## 1236   sep mon          DC  0.8408094742
## 1237   sep mon          DC  0.8408094742
## 1238   sep mon          DC  0.8408094742
## 1239   sep mon          DC  1.0279787201
## 1240   sep mon          DC  1.0279787201
```

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## 1241   sep mon          DC  1.0279787201
## 1242   sep mon          DC  1.0279787201
## 1243   sep fri          DC  0.7596014720
## 1244   sep fri          DC  0.7596014720
## 1245   sep fri          DC  0.7596014720
## 1246   sep fri          DC  0.7596014720
## 1247   sep fri          DC  0.7596014720
## 1248   sep fri          DC  0.7596014720
## 1249   sep fri          DC  0.7596014720
## 1250   sep fri          DC  0.7596014720
## 1251   sep fri          DC  0.9524161939
## 1252   sep fri          DC  0.9524161939
## 1253   sep fri          DC  0.9524161939
## 1254   sep fri          DC  0.7031467110
## 1255   sep tue          DC  0.8681683199
## 1256   sep tue          DC  0.8681683199
## 1257   sep tue          DC  0.8681683199
## 1258   sep tue          DC  1.0496920896
## 1259   sep sat          DC  0.7556930654
## 1260   sep sun          DC  1.1061468506
## 1261   sep fri          DC  1.2372956029
## 1262   sep sat          DC  0.7556930654
## 1263   aug sat          DC  0.6284527197
## 1264   jul wed          DC -0.4845746053
## 1265   aug thu          DC  0.3153459302
## 1266   aug wed          DC  0.5194516043
## 1267   aug thu          DC  0.7965142003
## 1268   aug sat          DC  1.0800908071
## 1269   aug sun          DC  0.1850657127
## 1270   sep sun          DC  0.7821833763
## 1271   aug fri          DC  0.5919742588
## 1272   feb mon          DC -2.2238155092
## 1273   sep fri          DC  0.7283342198
## 1274   sep sun          DC  1.1061468506
## 1275   feb sun          DC -2.2298952527
## 1276   sep sun          DC  0.7821833763
## 1277   aug sun          DC  0.1850657127
## 1278   jun wed          DC -1.1841793734
## 1279   sep thu          DC  0.7005411067
## 1280   sep wed          DC  0.6718794588
## 1281   sep sat          DC  1.2603117746
## 1282   sep fri          DC  1.2372956029
## 1283   feb fri          DC -2.2876528158
## 1284   jul mon          DC -0.5570972598
## 1285   aug thu          DC  0.5567986000
## 1286   jul tue          DC  0.0235182430
## 1287   aug sun          DC  0.4087134195
## 1288   aug sun          DC  0.1850657127
## 1289   aug wed          DC  0.2845129454
## 1290   jul sun          DC  0.9793407722
## 1291   sep sat          DC  0.7556930654
## 1292   aug sat          DC  0.6284527197
## 1293   aug mon          DC  0.4438890782
## 1294   aug sun          DC  0.1850657127
```

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## 1295   aug sat          DC  0.1516271235
## 1296   aug sun          DC  0.6631941110
## 1297   aug mon          DC  0.4438890782
## 1298   aug sat          DC  0.6284527197
## 1299   sep fri          DC  0.7283342198
## 1300   aug mon          DC  0.4438890782
## 1301   apr mon          DC -2.2963381637
## 1302   sep fri          DC  1.2372956029
## 1303   aug wed          DC  0.5194516043
## 1304   aug fri          DC  0.3453103803
## 1305   aug wed          DC  0.2845129454
## 1306   aug sat          DC  0.6284527197
## 1307   aug sat          DC  1.0800908071
## 1308   sep sun          DC  1.1061468506
## 1309   feb tue          DC -2.4066420812
## 1310   feb tue          DC -2.4066420812
## 1311   feb sat          DC -2.4105504877
## 1312   mar mon          DC -2.3167487311
## 1313   mar wed          DC -2.2985095006
## 1314   mar thu          DC -2.2880870832
## 1315   apr sun          DC -2.3658209463
## 1316   may fri          DC -2.1569383309
## 1317   jun mon          DC -1.4825210715
## 1318   jun sat          DC -1.3800339671
## 1319   jun thu          DC -1.1016685690
## 1320   jun thu          DC -0.9561889928
## 1321   jul thu          DC -0.7616372013
## 1322   jul sun          DC -0.6383052620
## 1323   jul sun          DC -0.6383052620
## 1324   jul mon          DC -0.6026953359
## 1325   jul thu          DC -0.0450960049
## 1326   aug sun          DC  0.0725904582
## 1327   aug sun          DC  0.0725904582
## 1328   aug mon          DC  0.1125430583
## 1329   aug tue          DC  0.1537984605
## 1330   aug tue          DC  0.1537984605
## 1331   aug tue          DC  0.1537984605
## 1332   aug fri          DC  0.2745247954
## 1333   aug sat          DC  0.3153459302
## 1334   aug mon          DC  0.3969881999
## 1335   aug tue          DC  0.4378093347
## 1336   aug tue          DC  0.4378093347
## 1337   aug tue          DC  0.4378093347
## 1338   aug wed          DC  0.5155431978
## 1339   aug wed          DC  0.5155431978
## 1340   aug thu          DC  0.7556930654
## 1341   aug fri          DC  0.7913029916
## 1342   aug fri          DC  0.7913029916
## 1343   aug sun          DC  0.4134903608
## 1344   aug sun          DC  0.4134903608
## 1345   aug sun          DC  0.4134903608
## 1346   jul tue         ISI -1.2688290456
## 1347   sep tue         ISI -0.5210189239
## 1348   sep mon         ISI -0.5210189239
```

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## 1349   aug wed         ISI  0.9746013193
## 1350   aug fri         ISI  0.8057409693
## 1351   jul sat         ISI -0.1109295024
## 1352   aug wed         ISI  0.9746013193
## 1353   aug thu         ISI  0.2991599191
## 1354   mar mon         ISI -0.7140021811
## 1355   sep tue         ISI -1.4376893956
## 1356   aug tue         ISI  1.8912717910
## 1357   sep thu         ISI  2.1083779553
## 1358   jun fri         ISI -0.4968960168
## 1359   jul sun         ISI -0.4727731096
## 1360   jul sat         ISI -0.7140021811
## 1361   sep fri         ISI  1.6259198124
## 1362   sep sat         ISI -0.2556669453
## 1363   aug sun         ISI  1.8912717910
## 1364   sep sat         ISI -0.2556669453
## 1365   aug wed         ISI  0.1061766620
## 1366   aug wed         ISI  0.1061766620
## 1367   sep fri         ISI  0.7333722478
## 1368   mar mon         ISI -0.7140021811
## 1369   aug thu         ISI  0.2991599191
## 1370   mar sat         ISI -0.3280356667
## 1371   sep sat         ISI -0.1350524095
## 1372   sep sun         ISI -1.0517228812
## 1373   mar thu         ISI -1.4859352099
## 1374   aug wed         ISI  0.1061766620
## 1375   aug wed         ISI  1.7706572553
## 1376   mar fri         ISI  0.8057409693
## 1377   aug thu         ISI  0.2991599191
## 1378   sep wed         ISI  0.0096850334
## 1379   aug wed         ISI -0.6175105525
## 1380   aug sun         ISI  0.3474057334
## 1381   sep mon         ISI -0.5210189239
## 1382   aug sat         ISI -0.0626836881
## 1383   aug sat         ISI -0.0626836881
## 1384   apr thu         ISI -1.5583039313
## 1385   aug sun         ISI -0.6898792740
## 1386   sep wed         ISI -0.7140021811
## 1387   aug tue         ISI -0.0385607809
## 1388   sep sun         ISI -0.1591753167
## 1389   oct mon         ISI -1.4859352099
## 1390   feb sun         ISI -1.2688290456
## 1391   oct mon         ISI  0.4680202692
## 1392   aug fri         ISI  1.4329365552
## 1393   sep tue         ISI -0.5210189239
## 1394   mar sun         ISI  0.1061766620
## 1395   sep mon         ISI -0.5210189239
## 1396   mar sat         ISI -0.3039127596
## 1397   mar sun         ISI -0.8828625312
## 1398   mar fri         ISI  0.8057409693
## 1399   aug thu         ISI  0.2991599191
## 1400   aug tue         ISI  1.8912717910
## 1401   sep wed         ISI  0.0096850334
## 1402   aug tue         ISI  1.8912717910
```

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## 1403   aug fri         ISI  1.4329365552
## 1404   apr thu         ISI -1.5583039313
## 1405   sep thu         ISI  0.0096850334
## 1406   sep tue         ISI -0.5210189239
## 1407   sep mon         ISI -2.0166391672
## 1408   sep tue         ISI -0.5210189239
## 1409   mar sun         ISI -0.4727731096
## 1410   feb sun         ISI -1.7030413742
## 1411   oct wed         ISI -0.9552312526
## 1412   mar sat         ISI -0.3280356667
## 1413   sep thu         ISI  0.0096850334
## 1414   aug sat         ISI  2.6873277269
## 1415   sep tue         ISI -0.5210189239
## 1416   sep fri         ISI  0.7333722478
## 1417   sep thu         ISI  2.1083779553
## 1418   oct sat         ISI -0.5933876454
## 1419   aug sat         ISI  2.6873277269
## 1420   sep fri         ISI  1.6259198124
## 1421   mar mon         ISI -1.0034770669
## 1422   mar sat         ISI -0.3280356667
## 1423   mar sat         ISI -0.3280356667
## 1424   sep sun         ISI -0.1591753167
## 1425   sep mon         ISI -0.4968960168
## 1426   sep wed         ISI  0.0096850334
## 1427   mar mon         ISI -0.7140021811
## 1428   aug sun         ISI -0.6898792740
## 1429   sep fri         ISI  1.1434616694
## 1430   mar mon         ISI -1.0034770669
## 1431   jul fri         ISI -0.5692647382
## 1432   sep wed         ISI -0.7140021811
## 1433   sep sun         ISI -0.2556669453
## 1434   oct mon         ISI  0.4680202692
## 1435   aug sat         ISI  0.6610035264
## 1436   sep sun         ISI -0.2556669453
## 1437   aug sat         ISI  0.6610035264
## 1438   sep wed         ISI  0.0096850334
## 1439   sep sun         ISI -0.2556669453
## 1440   sep tue         ISI -0.5210189239
## 1441   sep tue         ISI -1.4376893956
## 1442   sep sat         ISI -0.1350524095
## 1443   aug sun         ISI  0.3474057334
## 1444   sep sat         ISI -0.1350524095
## 1445   sep tue         ISI -0.5210189239
## 1446   sep sat         ISI -0.1350524095
## 1447   aug sun         ISI  0.9022325979
## 1448   aug sun         ISI  1.1193387622
## 1449   aug sun         ISI  1.1193387622
## 1450   aug wed         ISI  0.1061766620
## 1451   aug wed         ISI  1.0469700408
## 1452   aug wed         ISI  1.0469700408
## 1453   aug wed         ISI  1.0469700408
## 1454   aug wed         ISI  1.0469700408
## 1455   aug thu         ISI -0.2797898524
## 1456   aug thu         ISI -0.6898792740
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## 1457   aug sat         ISI  0.4438973620
## 1458   aug sat         ISI  0.4438973620
## 1459   aug sat         ISI  1.0952158551
## 1460   aug mon         ISI  1.2640762051
## 1461   aug fri         ISI -0.0626836881
## 1462   aug fri         ISI -0.0626836881
## 1463   aug fri         ISI -0.4968960168
## 1464   aug fri         ISI  0.9263555050
## 1465   aug tue         ISI  1.3123220194
## 1466   aug tue         ISI  3.2662774985
## 1467   aug tue         ISI  1.2399532980
## 1468   aug tue         ISI  1.2399532980
## 1469   aug tue         ISI  1.2399532980
## 1470   aug tue         ISI  1.2399532980
## 1471   dec sun         ISI -0.5692647382
## 1472   dec wed         ISI -0.9311083455
## 1473   dec thu         ISI -1.7271642814
## 1474   dec mon         ISI -1.5824268385
## 1475   dec mon         ISI -1.5824268385
## 1476   dec mon         ISI -1.5824268385
## 1477   dec mon         ISI -1.5824268385
## 1478   dec fri         ISI -1.2205832313
## 1479   dec tue         ISI -1.5824268385
## 1480   feb wed         ISI -1.4376893956
## 1481   feb fri         ISI -0.6898792740
## 1482   jul sat         ISI -0.0385607809
## 1483   jul fri         ISI -0.6898792740
## 1484   jul tue         ISI  0.4438973620
## 1485   jul tue         ISI -0.1591753167
## 1486   jun sun         ISI -0.6657563668
## 1487   jun mon         ISI -0.4004043882
## 1488   sep sun         ISI -0.8346167169
## 1489   sep sun         ISI -0.8346167169
## 1490   sep sun         ISI  0.1785453834
## 1491   sep wed         ISI -0.0868065952
## 1492   sep thu         ISI -0.1350524095
## 1493   sep thu         ISI -0.4004043882
## 1494   sep thu         ISI -0.4004043882
## 1495   sep thu         ISI -0.4004043882
## 1496   sep thu         ISI -0.4004043882
## 1497   sep thu         ISI -0.5692647382
## 1498   sep thu         ISI -0.9069854383
## 1499   sep sat         ISI -0.1832982238
## 1500   sep sat         ISI -0.1832982238
## 1501   sep sat         ISI -0.1591753167
## 1502   sep sat         ISI -0.1591753167
## 1503   sep mon         ISI  0.0820537548
## 1504   sep mon         ISI -0.7140021811
## 1505   sep mon         ISI -0.7140021811
## 1506   sep mon         ISI -0.7140021811
## 1507   sep mon         ISI -0.7140021811
## 1508   sep mon         ISI -0.4004043882
## 1509   sep mon         ISI -0.4004043882
## 1510   sep mon         ISI -0.4004043882
```

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## 1511   sep mon         ISI -0.4004043882
## 1512   sep fri         ISI  0.1061766620
## 1513   sep fri         ISI  0.1061766620
## 1514   sep fri         ISI  0.1061766620
## 1515   sep fri         ISI  0.1061766620
## 1516   sep fri         ISI  0.1061766620
## 1517   sep fri         ISI  0.1061766620
## 1518   sep fri         ISI  0.1061766620
## 1519   sep fri         ISI  0.1061766620
## 1520   sep fri         ISI  0.2509141048
## 1521   sep fri         ISI  0.2509141048
## 1522   sep fri         ISI  0.2509141048
## 1523   sep fri         ISI  0.5886348049
## 1524   sep tue         ISI -0.6416334597
## 1525   sep tue         ISI -0.6416334597
## 1526   sep tue         ISI -0.6416334597
## 1527   sep tue         ISI  0.8057409693
## 1528   sep sat         ISI -0.1832982238
## 1529   sep sun         ISI -0.4968960168
## 1530   sep fri         ISI -0.4245272953
## 1531   sep sat         ISI -0.1832982238
## 1532   aug sat         ISI -0.1832982238
## 1533   jul wed         ISI  0.6610035264
## 1534   aug thu         ISI -0.5692647382
## 1535   aug wed         ISI  2.1325008625
## 1536   aug thu         ISI -0.6898792740
## 1537   aug sat         ISI -0.3521585739
## 1538   aug sun         ISI -0.3762814810
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## 1540   aug fri         ISI  0.6851264335
## 1541   feb mon         ISI -1.2205832313
## 1542   sep fri         ISI -0.4727731096
## 1543   sep sun         ISI -0.4968960168
## 1544   feb sun         ISI -1.3653206742
## 1545   sep sun         ISI  0.5403889906
## 1546   aug sun         ISI -0.3762814810
## 1547   jun wed         ISI  1.1675845765
## 1548   sep thu         ISI -0.2074211310
## 1549   sep wed         ISI -1.3170748599
## 1550   sep sat         ISI -1.2447061384
## 1551   sep fri         ISI -0.4245272953
## 1552   feb fri         ISI -1.4135664885
## 1553   jul mon         ISI  0.1544224762
## 1554   aug thu         ISI  1.1434616694
## 1555   jul tue         ISI -0.0626836881
## 1556   aug sun         ISI -0.2556669453
## 1557   aug sun         ISI -0.3762814810
## 1558   aug wed         ISI -0.3280356667
## 1559   jul sun         ISI -0.9552312526
## 1560   sep sat         ISI -0.1832982238
## 1561   aug sat         ISI -0.1832982238
## 1562   aug mon         ISI -0.2315440381
## 1563   aug sun         ISI -0.3762814810
## 1564   aug sat         ISI  0.1061766620
```

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## 1565   aug sun         ISI  0.2267911977
## 1566   aug mon         ISI -0.2315440381
## 1567   aug sat         ISI -0.1832982238
## 1568   sep fri         ISI -0.4727731096
## 1569   aug mon         ISI -0.2315440381
## 1570   apr mon         ISI -1.3170748599
## 1571   sep fri         ISI -0.4245272953
## 1572   aug wed         ISI  2.1325008625
## 1573   aug fri         ISI  1.7224114410
## 1574   aug wed         ISI -0.3280356667
## 1575   aug sat         ISI -0.1832982238
## 1576   aug sat         ISI -0.3521585739
## 1577   sep sun         ISI -0.4968960168
## 1578   feb tue         ISI -1.7512871885
## 1579   feb tue         ISI -1.7512871885
## 1580   feb sat         ISI -1.7754100957
## 1581   mar mon         ISI -0.4968960168
## 1582   mar wed         ISI -0.4486502025
## 1583   mar thu         ISI -0.1591753167
## 1584   apr sun         ISI  0.7574951550
## 1585   may fri         ISI -0.8346167169
## 1586   jun mon         ISI -1.0758457884
## 1587   jun sat         ISI  0.0579308477
## 1588   jun thu         ISI  0.3956515477
## 1589   jun thu         ISI  2.1325008625
## 1590   jul thu         ISI  0.1785453834
## 1591   jul sun         ISI  1.3364449266
## 1592   jul sun         ISI  1.3364449266
## 1593   jul mon         ISI -0.6657563668
## 1594   jul thu         ISI  0.0820537548
## 1595   aug sun         ISI  1.1917074837
## 1596   aug sun         ISI  1.1917074837
## 1597   aug mon         ISI  2.9285567984
## 1598   aug tue         ISI  2.0601321410
## 1599   aug tue         ISI  2.0601321410
## 1600   aug tue         ISI  2.0601321410
## 1601   aug fri         ISI  0.5162660835
## 1602   aug sat         ISI  1.1675845765
## 1603   aug mon         ISI  1.8430259767
## 1604   aug tue         ISI  1.2399532980
## 1605   aug tue         ISI  1.2399532980
## 1606   aug tue         ISI  1.2399532980
## 1607   aug wed         ISI  2.6149590055
## 1608   aug wed         ISI  2.6149590055
## 1609   aug thu         ISI  0.2267911977
## 1610   aug fri         ISI -0.4968960168
## 1611   aug fri         ISI -0.4968960168
## 1612   aug sun         ISI -1.7512871885
## 1613   aug sun         ISI -1.7512871885
## 1614   aug sun         ISI -1.7512871885
## 1615   jul tue        temp -0.2083578670
## 1616   sep tue        temp  0.3904829792
## 1617   sep mon        temp  0.4228527546
## 1618   aug wed        temp  0.6494411829
```

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## 1619   aug fri        temp  0.3095585405
## 1620   jul sat        temp -0.4349462953
## 1621   aug wed        temp  0.7303656216
## 1622   aug thu        temp  1.3130215800
## 1623   mar mon        temp -0.9852324782
## 1624   sep tue        temp  0.7951051725
## 1625   aug tue        temp -0.3054671934
## 1626   sep thu        temp  0.7141807338
## 1627   jun fri        temp  0.6332562952
## 1628   jul sun        temp  0.8922144989
## 1629   jul sat        temp  0.8598447234
## 1630   sep fri        temp  0.1315247754
## 1631   sep sat        temp  1.6690891101
## 1632   aug sun        temp -0.4673160707
## 1633   sep sat        temp  1.5072402328
## 1634   aug wed        temp -0.1436183161
## 1635   aug wed        temp  0.1962643263
## 1636   sep fri        temp -0.0465089897
## 1637   mar mon        temp -0.5158707339
## 1638   aug thu        temp  0.1638945509
## 1639   mar sat        temp -0.6615347235
## 1640   sep sat        temp -0.2407276425
## 1641   sep sun        temp -0.2407276425
## 1642   mar thu        temp -2.2638386092
## 1643   aug wed        temp -0.4349462953
## 1644   aug wed        temp  0.6656260706
## 1645   mar fri        temp -0.7586440499
## 1646   aug thu        temp  0.2286341018
## 1647   sep wed        temp  0.4228527546
## 1648   aug wed        temp -0.3054671934
## 1649   aug sun        temp  0.1315247754
## 1650   sep mon        temp -0.2569125302
## 1651   aug sat        temp -0.8233836009
## 1652   aug sat        temp  0.1638945509
## 1653   apr thu        temp -2.1829141705
## 1654   aug sun        temp -0.0141392142
## 1655   sep wed        temp -0.1598032038
## 1656   aug tue        temp -0.7910138254
## 1657   sep sun        temp  0.7465505093
## 1658   oct mon        temp -0.0303241019
## 1659   feb sun        temp -1.1147115801
## 1660   oct mon        temp -0.4025765198
## 1661   aug fri        temp  0.2448189895
## 1662   sep tue        temp -0.2730974179
## 1663   mar sun        temp -1.2603755697
## 1664   sep mon        temp  0.2771887650
## 1665   mar sat        temp -0.9690475905
## 1666   mar sun        temp -1.2603755697
## 1667   mar fri        temp -1.2280057942
## 1668   aug thu        temp  0.7951051725
## 1669   aug tue        temp  0.8598447234
## 1670   sep wed        temp  0.8112900602
## 1671   aug tue        temp  0.8598447234
## 1672   aug fri        temp  0.6818109584
```

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## 1673   apr thu        temp -2.1829141705
## 1674   sep thu        temp  0.3581132037
## 1675   sep tue        temp -0.8719382641
## 1676   sep mon        temp  0.5361469688
## 1677   sep tue        temp  0.3742980914
## 1678   mar sun        temp -1.1147115801
## 1679   feb sun        temp -1.6973675385
## 1680   oct wed        temp  0.1477096631
## 1681   mar sat        temp -0.6777196113
## 1682   sep thu        temp  0.4552225301
## 1683   aug sat        temp  0.5847016320
## 1684   sep tue        temp  0.2286341018
## 1685   sep fri        temp  0.0506003367
## 1686   sep thu        temp  0.6332562952
## 1687   oct sat        temp -0.1436183161
## 1688   aug sat        temp -2.2962083847
## 1689   sep fri        temp  0.1315247754
## 1690   mar mon        temp -1.3413000084
## 1691   mar sat        temp -0.3702067443
## 1692   mar sat        temp -0.3702067443
## 1693   sep sun        temp -0.3863916321
## 1694   sep mon        temp -1.1147115801
## 1695   sep wed        temp  0.0182305613
## 1696   mar mon        temp -0.6615347235
## 1697   aug sun        temp -0.4996858462
## 1698   sep fri        temp -0.1112485406
## 1699   mar mon        temp -1.3413000084
## 1700   jul fri        temp -0.9528627028
## 1701   sep wed        temp -0.6291649481
## 1702   sep sun        temp  0.5847016320
## 1703   oct mon        temp -0.5158707339
## 1704   aug sat        temp  0.1315247754
## 1705   sep sun        temp  1.4586855696
## 1706   aug sat        temp -0.4673160707
## 1707   sep wed        temp  1.1511727026
## 1708   sep sun        temp  1.3777611309
## 1709   sep tue        temp -0.0950636529
## 1710   sep tue        temp  0.8112900602
## 1711   sep sat        temp -0.2569125302
## 1712   aug sun        temp  0.0506003367
## 1713   sep sat        temp -0.1759880915
## 1714   sep tue        temp -0.0788787651
## 1715   sep sat        temp  0.9407691621
## 1716   aug sun        temp -0.6291649481
## 1717   aug sun        temp  0.5037771933
## 1718   aug sun        temp  1.2159122536
## 1719   aug wed        temp  0.2286341018
## 1720   aug wed        temp  0.3904829792
## 1721   aug wed        temp  1.2159122536
## 1722   aug wed        temp  0.7627353970
## 1723   aug wed        temp  0.4552225301
## 1724   aug thu        temp  0.3419283160
## 1725   aug thu        temp -0.0626938774
## 1726   aug sat        temp  0.7465505093
```

```
## 1727   aug sat        temp  0.3419283160
## 1728   aug sat        temp  0.7141807338
## 1729   aug mon        temp  1.4586855696
## 1730   aug fri        temp -1.3089302329
## 1731   aug fri        temp  0.3419283160
## 1732   aug fri        temp  0.0020456735
## 1733   aug fri        temp  0.4066678669
## 1734   aug tue        temp  0.4552225301
## 1735   aug tue        temp  0.0182305613
## 1736   aug tue        temp -0.0303241019
## 1737   aug tue        temp  0.4066678669
## 1738   aug tue        temp  0.1315247754
## 1739   aug tue        temp  0.1477096631
## 1740   dec sun        temp -2.3447630479
## 1741   dec wed        temp -2.2962083847
## 1742   dec thu        temp -2.2962083847
## 1743   dec mon        temp -2.3771328233
## 1744   dec mon        temp -2.3771328233
## 1745   dec mon        temp -2.3771328233
## 1746   dec mon        temp -2.3771328233
## 1747   dec fri        temp -2.7655701289
## 1748   dec tue        temp -2.2962083847
## 1749   feb wed        temp -1.6973675385
## 1750   feb fri        temp -1.9077710790
## 1751   jul sat        temp  0.9731389376
## 1752   jul fri        temp  0.5847016320
## 1753   jul tue        temp  1.2320971413
## 1754   jul tue        temp -0.3540218566
## 1755   jun sun        temp -0.8071987131
## 1756   jun mon        temp -0.0303241019
## 1757   sep sun        temp -0.3540218566
## 1758   sep sun        temp  0.7303656216
## 1759   sep sun        temp  0.8922144989
## 1760   sep wed        temp  0.0667852245
## 1761   sep thu        temp -0.0141392142
## 1762   sep thu        temp  0.3742980914
## 1763   sep thu        temp -0.0626938774
## 1764   sep thu        temp -0.4025765198
## 1765   sep thu        temp -0.4025765198
## 1766   sep thu        temp -1.0337871414
## 1767   sep thu        temp -0.9043080396
## 1768   sep sat        temp  0.6818109584
## 1769   sep sat        temp  0.7951051725
## 1770   sep sat        temp  0.3581132037
## 1771   sep sat        temp -0.3540218566
## 1772   sep mon        temp -0.1921729793
## 1773   sep mon        temp  0.6008865197
## 1774   sep mon        temp  0.5523318565
## 1775   sep mon        temp  0.1800794386
## 1776   sep mon        temp  0.0020456735
## 1777   sep mon        temp -0.5482405094
## 1778   sep mon        temp -1.1470813556
## 1779   sep mon        temp -0.4025765198
## 1780   sep mon        temp  0.3257434282
```

```
## 1781   sep fri        temp -1.0499720292
## 1782   sep fri        temp -1.4869639980
## 1783   sep fri        temp -0.6291649481
## 1784   sep fri        temp  0.2124492141
## 1785   sep fri        temp  0.0829701122
## 1786   sep fri        temp -0.0950636529
## 1787   sep fri        temp  0.2448189895
## 1788   sep fri        temp  0.2448189895
## 1789   sep fri        temp  0.2933736528
## 1790   sep fri        temp -0.1436183161
## 1791   sep fri        temp -0.3216520811
## 1792   sep fri        temp -0.6615347235
## 1793   sep tue        temp -0.5482405094
## 1794   sep tue        temp  0.2933736528
## 1795   sep tue        temp  0.0506003367
## 1796   sep tue        temp -0.5482405094
## 1797   sep sat        temp -0.4025765198
## 1798   sep sun        temp -0.8881231518
## 1799   sep fri        temp -1.4545942225
## 1800   sep sat        temp -0.6291649481
## 1801   aug sat        temp  0.4228527546
## 1802   jul wed        temp  0.0020456735
## 1803   aug thu        temp -0.4996858462
## 1804   aug wed        temp  1.4425006819
## 1805   aug thu        temp  0.1962643263
## 1806   aug sat        temp  0.3257434282
## 1807   aug sun        temp  0.2610038773
## 1808   sep sun        temp  0.2124492141
## 1809   aug fri        temp  0.6494411829
## 1810   feb mon        temp -1.9077710790
## 1811   sep fri        temp  0.2286341018
## 1812   sep sun        temp  0.4228527546
## 1813   feb sun        temp -1.4869639980
## 1814   sep sun        temp  0.1800794386
## 1815   aug sun        temp  0.8112900602
## 1816   jun wed        temp  1.4101309064
## 1817   sep thu        temp  0.5685167442
## 1818   sep wed        temp  0.4066678669
## 1819   sep sat        temp -0.3702067443
## 1820   sep fri        temp  0.0991549999
## 1821   feb fri        temp -1.7944768649
## 1822   jul mon        temp  0.5685167442
## 1823   aug thu        temp  1.3292064677
## 1824   jul tue        temp  1.1349878149
## 1825   aug sun        temp  0.9083993866
## 1826   aug sun        temp  0.8922144989
## 1827   aug wed        temp  1.1188029272
## 1828   jul sun        temp  1.6205344469
## 1829   sep sat        temp  0.4875923056
## 1830   aug sat        temp  1.2320971413
## 1831   aug mon        temp  1.3939460187
## 1832   aug sun        temp  0.8598447234
## 1833   aug sat        temp  0.6494411829
## 1834   aug sun        temp  0.2610038773
```

```
## 1835   aug mon        temp  1.2159122536
## 1836   aug sat        temp  0.6979958461
## 1837   sep fri        temp -0.0303241019
## 1838   aug mon        temp  1.0055087130
## 1839   apr mon        temp -1.3574848961
## 1840   sep fri        temp -0.4996858462
## 1841   aug wed        temp  0.6656260706
## 1842   aug fri        temp -1.2118209065
## 1843   aug wed        temp  0.0991549999
## 1844   aug sat        temp -0.0626938774
## 1845   aug sat        temp -0.6129800603
## 1846   sep sun        temp -0.7748289377
## 1847   feb tue        temp -2.3771328233
## 1848   feb tue        temp -2.2962083847
## 1849   feb sat        temp -2.3771328233
## 1850   mar mon        temp -1.4707791102
## 1851   mar wed        temp -1.3089302329
## 1852   mar thu        temp -0.9690475905
## 1853   apr sun        temp -0.9043080396
## 1854   may fri        temp -0.2083578670
## 1855   jun mon        temp -0.8071987131
## 1856   jun sat        temp  0.8436598357
## 1857   jun thu        temp  1.1511727026
## 1858   jun thu        temp  0.5523318565
## 1859   jul thu        temp  1.2806518045
## 1860   jul sun        temp  1.1026180394
## 1861   jul sun        temp -0.1759880915
## 1862   jul mon        temp  0.5361469688
## 1863   jul thu        temp  1.7661984365
## 1864   aug sun        temp  0.6656260706
## 1865   aug sun        temp  2.2355601808
## 1866   aug mon        temp  1.8309379875
## 1867   aug tue        temp  0.7789202848
## 1868   aug tue        temp  1.1511727026
## 1869   aug tue        temp  0.0182305613
## 1870   aug fri        temp  1.3292064677
## 1871   aug sat        temp  1.8633077629
## 1872   aug mon        temp  2.1546357421
## 1873   aug tue        temp  2.1060810789
## 1874   aug tue        temp  2.2679299563
## 1875   aug tue        temp  1.2968366922
## 1876   aug wed        temp  1.6043495592
## 1877   aug wed        temp  1.5557948960
## 1878   aug thu        temp  1.1997273658
## 1879   aug fri        temp  0.2933736528
## 1880   aug fri        temp -0.1759880915
## 1881   aug sun        temp  1.3777611309
## 1882   aug sun        temp  0.4228527546
## 1883   aug sun        temp  0.3095585405
## 1884   jul tue          RH -0.1159142113
## 1885   sep tue          RH -0.3807203501
## 1886   sep mon          RH -0.3145188154
## 1887   aug wed          RH -0.8441310930
## 1888   aug fri          RH  0.4798996010
```

```
## 1889   jul sat          RH  0.6123026703
## 1890   aug wed          RH -0.7779295583
## 1891   aug thu          RH -1.4399449052
## 1892   mar mon          RH -0.2483172807
## 1893   sep tue          RH -1.0427356971
## 1894   aug tue          RH -0.0497126766
## 1895   sep thu          RH -1.2413403011
## 1896   jun fri          RH -0.3145188154
## 1897   jul sun          RH -0.9765341624
## 1898   jul sat          RH -0.0497126766
## 1899   sep fri          RH  0.2150934622
## 1900   sep sat          RH -1.1089372317
## 1901   aug sun          RH  0.2150934622
## 1902   sep sat          RH -1.1089372317
## 1903   aug wed          RH  0.0826903928
## 1904   aug wed          RH -0.5793249542
## 1905   sep fri          RH -0.6455264889
## 1906   mar mon          RH -0.9765341624
## 1907   aug thu          RH -0.1821157460
## 1908   mar sat          RH -0.8441310930
## 1909   sep sat          RH  0.8109072744
## 1910   sep sun          RH  1.5391241561
## 1911   mar thu          RH  1.7377287602
## 1912   aug wed          RH  0.2150934622
## 1913   aug wed          RH -0.7117280236
## 1914   mar fri          RH -1.1751387664
## 1915   aug thu          RH  0.0826903928
## 1916   sep wed          RH -0.5793249542
## 1917   aug wed          RH  0.4136980663
## 1918   aug sun          RH -0.3145188154
## 1919   sep mon          RH -0.3145188154
## 1920   aug sat          RH  0.6123026703
## 1921   aug sat          RH -0.3145188154
## 1922   apr thu          RH  0.6785042050
## 1923   aug sun          RH  0.0164888581
## 1924   sep wed          RH  0.0826903928
## 1925   aug tue          RH  1.4729226214
## 1926   sep sun          RH -0.7779295583
## 1927   oct mon          RH -0.7779295583
## 1928   feb sun          RH  0.6123026703
## 1929   oct mon          RH  0.0826903928
## 1930   aug fri          RH -0.6455264889
## 1931   sep tue          RH  0.1488919275
## 1932   mar sun          RH -0.3145188154
## 1933   sep mon          RH -0.1159142113
## 1934   mar sat          RH -0.1159142113
## 1935   mar sun          RH  1.0757134132
## 1936   mar fri          RH -0.7117280236
## 1937   aug thu          RH -1.0427356971
## 1938   aug tue          RH -1.4399449052
## 1939   sep wed          RH -1.2413403011
## 1940   aug tue          RH -1.4399449052
## 1941   aug fri          RH -0.5131234195
## 1942   apr thu          RH  0.6785042050
```

```
## 1943   sep thu          RH -1.9033556481
## 1944   sep tue          RH  1.0095118785
## 1945   sep mon          RH -0.3807203501
## 1946   sep tue          RH -0.7117280236
## 1947   mar sun          RH  0.6785042050
## 1948   feb sun          RH  1.6053256908
## 1949   oct wed          RH -0.4469218848
## 1950   mar sat          RH  1.3405195520
## 1951   sep thu          RH -0.6455264889
## 1952   aug sat          RH -0.8441310930
## 1953   sep tue          RH -0.4469218848
## 1954   sep fri          RH -0.7117280236
## 1955   sep thu          RH -1.1751387664
## 1956   oct sat          RH -1.2413403011
## 1957   aug sat          RH  3.4589686623
## 1958   sep fri          RH  0.2150934622
## 1959   mar mon          RH  0.1488919275
## 1960   mar sat          RH -1.1089372317
## 1961   mar sat          RH -1.1089372317
## 1962   sep sun          RH  1.0757134132
## 1963   sep mon          RH  1.9363333643
## 1964   sep wed          RH -1.6385495093
## 1965   mar mon          RH -1.1089372317
## 1966   aug sun          RH  1.0095118785
## 1967   sep fri          RH  0.3474965316
## 1968   mar mon          RH  0.1488919275
## 1969   jul fri          RH  2.3335425724
## 1970   sep wed          RH  0.8771088091
## 1971   sep sun          RH -0.3145188154
## 1972   oct mon          RH  0.0164888581
## 1973   aug sat          RH -0.6455264889
## 1974   sep sun          RH -1.1751387664
## 1975   aug sat          RH -0.0497126766
## 1976   sep wed          RH -1.5061464399
## 1977   sep sun          RH -1.1089372317
## 1978   sep tue          RH -0.0497126766
## 1979   sep tue          RH -0.5131234195
## 1980   sep sat          RH -1.2413403011
## 1981   aug sun          RH -0.1821157460
## 1982   sep sat          RH  0.1488919275
## 1983   sep tue          RH -0.2483172807
## 1984   sep sat          RH -1.1089372317
## 1985   aug sun          RH  1.4729226214
## 1986   aug sun          RH  0.6785042050
## 1987   aug sun          RH -0.3807203501
## 1988   aug wed          RH  1.7377287602
## 1989   aug wed          RH -0.2483172807
## 1990   aug wed          RH -1.2413403011
## 1991   aug wed          RH -0.5131234195
## 1992   aug wed          RH -0.4469218848
## 1993   aug thu          RH -0.3807203501
## 1994   aug thu          RH -0.1821157460
## 1995   aug sat          RH -0.1821157460
## 1996   aug sat          RH  0.0164888581
```

```
## 1997   aug sat          RH -0.2483172807
## 1998   aug mon          RH -0.7779295583
## 1999   aug fri          RH  2.6645502459
## 2000   aug fri          RH -0.1159142113
## 2001   aug fri          RH -0.3145188154
## 2002   aug fri          RH  0.6123026703
## 2003   aug tue          RH  0.6785042050
## 2004   aug tue          RH  0.7447057397
## 2005   aug tue          RH  0.6123026703
## 2006   aug tue          RH  0.8109072744
## 2007   aug tue          RH  0.9433103438
## 2008   aug tue          RH  0.2150934622
## 2009   dec sun          RH  0.8771088091
## 2010   dec wed          RH  1.1419149479
## 2011   dec thu          RH  1.1419149479
## 2012   dec mon          RH -1.5061464399
## 2013   dec mon          RH -1.5061464399
## 2014   dec mon          RH -1.5061464399
## 2015   dec mon          RH -1.5061464399
## 2016   dec fri          RH  1.0095118785
## 2017   dec tue          RH -1.3075418358
## 2018   feb wed          RH -0.5793249542
## 2019   feb fri          RH  0.1488919275
## 2020   jul sat          RH -0.3145188154
## 2021   jul fri          RH -0.2483172807
## 2022   jul tue          RH -1.0427356971
## 2023   jul tue          RH  1.5391241561
## 2024   jun sun          RH  0.1488919275
## 2025   jun mon          RH -0.3145188154
## 2026   sep sun          RH  0.6123026703
## 2027   sep sun          RH -0.5793249542
## 2028   sep sun          RH -1.0427356971
## 2029   sep wed          RH -0.1821157460
## 2030   sep thu          RH -1.3075418358
## 2031   sep thu          RH -1.0427356971
## 2032   sep thu          RH -0.6455264889
## 2033   sep thu          RH -1.0427356971
## 2034   sep thu          RH -1.0427356971
## 2035   sep thu          RH -0.3145188154
## 2036   sep thu          RH  0.8109072744
## 2037   sep sat          RH -1.1089372317
## 2038   sep sat          RH -1.1089372317
## 2039   sep sat          RH -1.0427356971
## 2040   sep sat          RH -0.1821157460
## 2041   sep mon          RH  0.6785042050
## 2042   sep mon          RH -0.6455264889
## 2043   sep mon          RH -0.5793249542
## 2044   sep mon          RH -0.1821157460
## 2045   sep mon          RH  0.0164888581
## 2046   sep mon          RH  0.4798996010
## 2047   sep mon          RH  1.4729226214
## 2048   sep mon          RH -0.0497126766
## 2049   sep mon          RH -0.5793249542
## 2050   sep fri          RH  1.3405195520
```

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## 2051   sep fri          RH  2.0687364337
## 2052   sep fri          RH  0.6123026703
## 2053   sep fri          RH -0.0497126766
## 2054   sep fri          RH  0.2150934622
## 2055   sep fri          RH  0.4136980663
## 2056   sep fri          RH -0.5793249542
## 2057   sep fri          RH -0.5793249542
## 2058   sep fri          RH -0.3145188154
## 2059   sep fri          RH -0.1159142113
## 2060   sep fri          RH  0.0826903928
## 2061   sep fri          RH  1.3405195520
## 2062   sep tue          RH  0.6123026703
## 2063   sep tue          RH -0.5793249542
## 2064   sep tue          RH  0.0826903928
## 2065   sep tue          RH -0.3807203501
## 2066   sep sat          RH  0.2150934622
## 2067   sep sun          RH  2.2011395031
## 2068   sep fri          RH  2.2673410377
## 2069   sep sat          RH  0.8771088091
## 2070   aug sat          RH -0.1159142113
## 2071   jul wed          RH -0.3145188154
## 2072   aug thu          RH  1.2743180173
## 2073   aug wed          RH -0.9765341624
## 2074   aug thu          RH  0.9433103438
## 2075   aug sat          RH  0.0164888581
## 2076   aug sun          RH  0.4136980663
## 2077   sep sun          RH  0.7447057397
## 2078   aug fri          RH -0.6455264889
## 2079   feb mon          RH  1.8039302949
## 2080   sep fri          RH  0.1488919275
## 2081   sep sun          RH -0.0497126766
## 2082   feb sun          RH  1.2081164826
## 2083   sep sun          RH  0.7447057397
## 2084   aug sun          RH -0.7117280236
## 2085   jun wed          RH -0.6455264889
## 2086   sep thu          RH  0.1488919275
## 2087   sep wed          RH -0.6455264889
## 2088   sep sat          RH  1.5391241561
## 2089   sep fri          RH  0.0164888581
## 2090   feb fri          RH  0.6123026703
## 2091   jul mon          RH -1.1089372317
## 2092   aug thu          RH -1.1089372317
## 2093   jul tue          RH -0.3145188154
## 2094   aug sun          RH -0.1159142113
## 2095   aug sun          RH -0.5131234195
## 2096   aug wed          RH -0.5131234195
## 2097   jul sun          RH -1.1089372317
## 2098   sep sat          RH  0.2812949969
## 2099   aug sat          RH -0.8441310930
## 2100   aug mon          RH -0.7117280236
## 2101   aug sun          RH  0.0164888581
## 2102   aug sat          RH -0.2483172807
## 2103   aug sun          RH  1.4729226214
## 2104   aug mon          RH -0.5793249542
```

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## 2105   aug sat          RH  0.6123026703
## 2106   sep fri          RH  0.1488919275
## 2107   aug mon          RH -0.9765341624
## 2108   apr mon          RH  1.3405195520
## 2109   sep fri          RH  0.9433103438
## 2110   aug wed          RH  0.3474965316
## 2111   aug fri          RH  2.9293563847
## 2112   aug wed          RH  0.4136980663
## 2113   aug sat          RH  1.3405195520
## 2114   aug sat          RH  1.8701318296
## 2115   sep sun          RH  2.1349379684
## 2116   feb tue          RH  2.5321471765
## 2117   feb tue          RH  2.2011395031
## 2118   feb sat          RH  1.0095118785
## 2119   mar mon          RH  0.0826903928
## 2120   mar wed          RH -0.1821157460
## 2121   mar thu          RH -1.1089372317
## 2122   apr sun          RH -0.7117280236
## 2123   may fri          RH -0.2483172807
## 2124   jun mon          RH  2.3335425724
## 2125   jun sat          RH  0.4136980663
## 2126   jun thu          RH -0.5793249542
## 2127   jun thu          RH -0.2483172807
## 2128   jul thu          RH -1.0427356971
## 2129   jul sun          RH  0.0826903928
## 2130   jul sun          RH  2.5321471765
## 2131   jul mon          RH  0.8771088091
## 2132   jul thu          RH -1.2413403011
## 2133   aug sun          RH -0.2483172807
## 2134   aug sun          RH -1.2413403011
## 2135   aug mon          RH -1.0427356971
## 2136   aug tue          RH -0.0497126766
## 2137   aug tue          RH -0.6455264889
## 2138   aug tue          RH  1.8039302949
## 2139   aug fri          RH -0.9765341624
## 2140   aug sat          RH -0.9103326277
## 2141   aug mon          RH -1.1751387664
## 2142   aug tue          RH -1.1089372317
## 2143   aug tue          RH -1.1751387664
## 2144   aug tue          RH  1.2743180173
## 2145   aug wed          RH -0.9103326277
## 2146   aug wed          RH -0.9765341624
## 2147   aug thu          RH -0.5793249542
## 2148   aug fri          RH  1.8039302949
## 2149   aug fri          RH  1.2081164826
## 2150   aug sun          RH -0.7779295583
## 2151   aug sun          RH  1.8039302949
## 2152   aug sun          RH  1.7377287602
## 2153   jul tue        wind -0.7464731398
## 2154   sep tue        wind -1.0115223408
## 2155   sep mon        wind -1.2235617015
## 2156   aug wed        wind  0.2077039835
## 2157   aug fri        wind  2.5401369516
## 2158   jul sat        wind  0.6847925451
```

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## 2159   aug wed        wind  0.6847925451
## 2160   aug thu        wind -0.0573452174
## 2161   mar mon        wind  0.6847925451
## 2162   sep tue        wind -0.2693845782
## 2163   aug tue        wind  1.3739204675
## 2164   sep thu        wind  0.2077039835
## 2165   jun fri        wind  0.6847925451
## 2166   jul sun        wind -1.0115223408
## 2167   jul sat        wind -1.2235617015
## 2168   sep fri        wind  0.4197433442
## 2169   sep sat        wind -0.7464731398
## 2170   aug sun        wind -1.4886109024
## 2171   sep sat        wind -1.0115223408
## 2172   aug wed        wind -0.2693845782
## 2173   aug wed        wind -0.0573452174
## 2174   sep fri        wind  0.8968319059
## 2175   mar mon        wind -0.5344337791
## 2176   aug thu        wind -0.0573452174
## 2177   mar sat        wind  2.3280975908
## 2178   sep sat        wind -1.2235617015
## 2179   sep sun        wind -1.0115223408
## 2180   mar thu        wind  0.2077039835
## 2181   aug wed        wind -1.7006502631
## 2182   aug wed        wind  0.2077039835
## 2183   mar fri        wind  2.8051861525
## 2184   aug thu        wind -1.0115223408
## 2185   sep wed        wind -1.2235617015
## 2186   aug wed        wind -0.0573452174
## 2187   aug sun        wind  0.6847925451
## 2188   sep mon        wind -1.0115223408
## 2189   aug sat        wind -1.2235617015
## 2190   aug sat        wind  0.4197433442
## 2191   apr thu        wind  0.8968319059
## 2192   aug sun        wind -0.7464731398
## 2193   sep wed        wind -1.0115223408
## 2194   aug tue        wind  0.6847925451
## 2195   sep sun        wind  1.3739204675
## 2196   oct mon        wind -0.0573452174
## 2197   feb sun        wind -1.0115223408
## 2198   oct mon        wind  0.2077039835
## 2199   aug fri        wind  0.4197433442
## 2200   sep tue        wind -0.5344337791
## 2201   mar sun        wind  0.8968319059
## 2202   sep mon        wind -1.0115223408
## 2203   mar sat        wind -1.7006502631
## 2204   mar sun        wind -0.0573452174
## 2205   mar fri        wind -0.0573452174
## 2206   aug thu        wind -0.7464731398
## 2207   aug tue        wind  0.2077039835
## 2208   sep wed        wind -0.0573452174
## 2209   aug tue        wind  0.2077039835
## 2210   aug fri        wind  0.6847925451
## 2211   apr thu        wind  0.8968319059
## 2212   sep thu        wind -1.7006502631
```

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## 2213   sep tue        wind  1.1618811068
## 2214   sep mon        wind -0.2693845782
## 2215   sep tue        wind -1.0115223408
## 2216   mar sun        wind -0.2693845782
## 2217   feb sun        wind -1.0115223408
## 2218   oct wed        wind -0.7464731398
## 2219   mar sat        wind -0.0573452174
## 2220   sep thu        wind -1.2235617015
## 2221   aug sat        wind  1.6389696684
## 2222   sep tue        wind -1.0115223408
## 2223   sep fri        wind  1.1618811068
## 2224   sep thu        wind  0.4197433442
## 2225   oct sat        wind -0.5344337791
## 2226   aug sat        wind  0.8968319059
## 2227   sep fri        wind  0.4197433442
## 2228   mar mon        wind  0.8968319059
## 2229   mar sat        wind  0.4197433442
## 2230   mar sat        wind  0.4197433442
## 2231   sep sun        wind -1.4886109024
## 2232   sep mon        wind  1.1618811068
## 2233   sep wed        wind -1.4886109024
## 2234   mar mon        wind -0.5344337791
## 2235   aug sun        wind -0.5344337791
## 2236   sep fri        wind -0.2693845782
## 2237   mar mon        wind  0.8968319059
## 2238   jul fri        wind -0.2693845782
## 2239   sep wed        wind  0.2077039835
## 2240   sep sun        wind  0.4197433442
## 2241   oct mon        wind -0.0573452174
## 2242   aug sat        wind  0.2077039835
## 2243   sep sun        wind -0.5344337791
## 2244   aug sat        wind -0.0573452174
## 2245   sep wed        wind  0.2077039835
## 2246   sep sun        wind -0.5344337791
## 2247   sep tue        wind -0.7464731398
## 2248   sep tue        wind -0.5344337791
## 2249   sep sat        wind -0.5344337791
## 2250   aug sun        wind  0.8968319059
## 2251   sep sat        wind -1.2235617015
## 2252   sep tue        wind -1.0115223408
## 2253   sep sat        wind -0.0573452174
## 2254   aug sun        wind -0.0573452174
## 2255   aug sun        wind  1.8510090292
## 2256   aug sun        wind  1.1618811068
## 2257   aug wed        wind -1.0115223408
## 2258   aug wed        wind -1.9656994641
## 2259   aug wed        wind -0.5344337791
## 2260   aug wed        wind -0.5344337791
## 2261   aug wed        wind -0.2693845782
## 2262   aug thu        wind -0.7464731398
## 2263   aug thu        wind -0.5344337791
## 2264   aug sat        wind -1.0115223408
## 2265   aug sat        wind -0.7464731398
## 2266   aug sat        wind -1.2235617015
```

```
## 2267   aug mon        wind -0.0573452174
## 2268   aug fri        wind  1.8510090292
## 2269   aug fri        wind -0.5344337791
## 2270   aug fri        wind -0.2693845782
## 2271   aug fri        wind -0.5344337791
## 2272   aug tue        wind  1.8510090292
## 2273   aug tue        wind -0.0573452174
## 2274   aug tue        wind -0.7464731398
## 2275   aug tue        wind -0.5344337791
## 2276   aug tue        wind  0.2077039835
## 2277   aug tue        wind -0.0573452174
## 2278   dec sun        wind  2.3280975908
## 2279   dec wed        wind  2.0630483899
## 2280   dec thu        wind  0.4197433442
## 2281   dec mon        wind  2.3280975908
## 2282   dec mon        wind  2.3280975908
## 2283   dec mon        wind  2.3280975908
## 2284   dec mon        wind  2.3280975908
## 2285   dec fri        wind  0.4197433442
## 2286   dec tue        wind  2.3280975908
## 2287   feb wed        wind -0.5344337791
## 2288   feb fri        wind  2.0630483899
## 2289   jul sat        wind -1.7006502631
## 2290   jul fri        wind -1.4886109024
## 2291   jul tue        wind  0.6847925451
## 2292   jul tue        wind -0.2693845782
## 2293   jun sun        wind -1.2235617015
## 2294   jun mon        wind  0.6847925451
## 2295   sep sun        wind  0.6847925451
## 2296   sep sun        wind -0.2693845782
## 2297   sep sun        wind -1.2235617015
## 2298   sep wed        wind -1.2235617015
## 2299   sep thu        wind  0.4197433442
## 2300   sep thu        wind  1.1618811068
## 2301   sep thu        wind  1.6389696684
## 2302   sep thu        wind -0.0573452174
## 2303   sep thu        wind -0.0573452174
## 2304   sep thu        wind -0.7464731398
## 2305   sep thu        wind -1.2235617015
## 2306   sep sat        wind -0.0573452174
## 2307   sep sat        wind -0.5344337791
## 2308   sep sat        wind  0.2077039835
## 2309   sep sat        wind -1.0115223408
## 2310   sep mon        wind -0.5344337791
## 2311   sep mon        wind -1.0115223408
## 2312   sep mon        wind -1.0115223408
## 2313   sep mon        wind -1.2235617015
## 2314   sep mon        wind -1.0115223408
## 2315   sep mon        wind  0.2077039835
## 2316   sep mon        wind  0.4197433442
## 2317   sep mon        wind -0.5344337791
## 2318   sep mon        wind -1.0115223408
## 2319   sep fri        wind -0.2693845782
## 2320   sep fri        wind -0.2693845782
```

```
## 2321   sep fri        wind  1.1618811068
## 2322   sep fri        wind -0.2693845782
## 2323   sep fri        wind -0.7464731398
## 2324   sep fri        wind -1.0115223408
## 2325   sep fri        wind  0.4197433442
## 2326   sep fri        wind  0.4197433442
## 2327   sep fri        wind -1.0115223408
## 2328   sep fri        wind -1.0115223408
## 2329   sep fri        wind -0.0573452174
## 2330   sep fri        wind -0.5344337791
## 2331   sep tue        wind -1.0115223408
## 2332   sep tue        wind -0.7464731398
## 2333   sep tue        wind -0.5344337791
## 2334   sep tue        wind  0.6847925451
## 2335   sep sat        wind  0.4197433442
## 2336   sep sun        wind  1.8510090292
## 2337   sep fri        wind -0.0573452174
## 2338   sep sat        wind  0.4197433442
## 2339   aug sat        wind -1.0115223408
## 2340   jul wed        wind  1.6389696684
## 2341   aug thu        wind -0.7464731398
## 2342   aug wed        wind -1.2235617015
## 2343   aug thu        wind -0.7464731398
## 2344   aug sat        wind  0.2077039835
## 2345   aug sun        wind -1.0115223408
## 2346   sep sun        wind  0.6847925451
## 2347   aug fri        wind -0.5344337791
## 2348   feb mon        wind  1.1618811068
## 2349   sep fri        wind -0.7464731398
## 2350   sep sun        wind -0.0573452174
## 2351   feb sun        wind -1.2235617015
## 2352   sep sun        wind  0.4197433442
## 2353   aug sun        wind -0.2693845782
## 2354   jun wed        wind  0.2077039835
## 2355   sep thu        wind -0.0573452174
## 2356   sep wed        wind -1.0115223408
## 2357   sep sat        wind  0.4197433442
## 2358   sep fri        wind -0.5344337791
## 2359   feb fri        wind  2.8051861525
## 2360   jul mon        wind  0.2077039835
## 2361   aug thu        wind  0.4197433442
## 2362   jul tue        wind -0.5344337791
## 2363   aug sun        wind  0.6847925451
## 2364   aug sun        wind -0.0573452174
## 2365   aug wed        wind  0.2077039835
## 2366   jul sun        wind -0.2693845782
## 2367   sep sat        wind -0.0573452174
## 2368   aug sat        wind -0.2693845782
## 2369   aug mon        wind -1.0115223408
## 2370   aug sun        wind -0.0573452174
## 2371   aug sat        wind -0.0573452174
## 2372   aug sun        wind  0.4197433442
## 2373   aug mon        wind -1.4886109024
## 2374   aug sat        wind -0.0573452174
```

```
## 2375   sep fri        wind -1.0115223408
## 2376   aug mon        wind -1.2235617015
## 2377   apr mon        wind -0.5344337791
## 2378   sep fri        wind -0.2693845782
## 2379   aug wed        wind  0.6847925451
## 2380   aug fri        wind  0.4197433442
## 2381   aug wed        wind -0.0573452174
## 2382   aug sat        wind  0.4197433442
## 2383   aug sat        wind  2.0630483899
## 2384   sep sun        wind  1.8510090292
## 2385   feb tue        wind  1.1618811068
## 2386   feb tue        wind  0.6847925451
## 2387   feb sat        wind -1.7006502631
## 2388   mar mon        wind  0.8968319059
## 2389   mar wed        wind  0.6847925451
## 2390   mar thu        wind -0.2693845782
## 2391   apr sun        wind  2.8051861525
## 2392   may fri        wind -0.0573452174
## 2393   jun mon        wind -0.0573452174
## 2394   jun sat        wind -0.5344337791
## 2395   jun thu        wind -0.7464731398
## 2396   jun thu        wind  2.8051861525
## 2397   jul thu        wind -1.4886109024
## 2398   jul sun        wind -0.0573452174
## 2399   jul sun        wind  0.2077039835
## 2400   jul mon        wind  0.4197433442
## 2401   jul thu        wind  0.2077039835
## 2402   aug sun        wind  0.8968319059
## 2403   aug sun        wind -0.0573452174
## 2404   aug mon        wind -0.2693845782
## 2405   aug tue        wind  1.1618811068
## 2406   aug tue        wind -0.2693845782
## 2407   aug tue        wind  1.8510090292
## 2408   aug fri        wind  0.2077039835
## 2409   aug sat        wind  0.4197433442
## 2410   aug mon        wind -0.5344337791
## 2411   aug tue        wind -1.0115223408
## 2412   aug tue        wind -0.7464731398
## 2413   aug tue        wind  0.4197433442
## 2414   aug wed        wind  0.4197433442
## 2415   aug wed        wind  0.4197433442
## 2416   aug thu        wind -1.2235617015
## 2417   aug fri        wind  1.8510090292
## 2418   aug fri        wind  0.6847925451
## 2419   aug sun        wind -0.7464731398
## 2420   aug sun        wind  0.8968319059
## 2421   aug sun        wind  1.3739204675
## 2422   jul tue        rain -0.0726485861
## 2423   sep tue        rain -0.0726485861
## 2424   sep mon        rain -0.0726485861
## 2425   aug wed        rain -0.0726485861
## 2426   aug fri        rain -0.0726485861
## 2427   jul sat        rain -0.0726485861
## 2428   aug wed        rain -0.0726485861
```

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## 2429   aug thu        rain -0.0726485861
## 2430   mar mon        rain -0.0726485861
## 2431   sep tue        rain -0.0726485861
## 2432   aug tue        rain -0.0726485861
## 2433   sep thu        rain -0.0726485861
## 2434   jun fri        rain -0.0726485861
## 2435   jul sun        rain -0.0726485861
## 2436   jul sat        rain -0.0726485861
## 2437   sep fri        rain -0.0726485861
## 2438   sep sat        rain -0.0726485861
## 2439   aug sun        rain -0.0726485861
## 2440   sep sat        rain -0.0726485861
## 2441   aug wed        rain -0.0726485861
## 2442   aug wed        rain -0.0726485861
## 2443   sep fri        rain -0.0726485861
## 2444   mar mon        rain -0.0726485861
## 2445   aug thu        rain -0.0726485861
## 2446   mar sat        rain -0.0726485861
## 2447   sep sat        rain -0.0726485861
## 2448   sep sun        rain -0.0726485861
## 2449   mar thu        rain -0.0726485861
## 2450   aug wed        rain -0.0726485861
## 2451   aug wed        rain -0.0726485861
## 2452   mar fri        rain -0.0726485861
## 2453   aug thu        rain -0.0726485861
## 2454   sep wed        rain -0.0726485861
## 2455   aug wed        rain -0.0726485861
## 2456   aug sun        rain -0.0726485861
## 2457   sep mon        rain -0.0726485861
## 2458   aug sat        rain -0.0726485861
## 2459   aug sat        rain -0.0726485861
## 2460   apr thu        rain -0.0726485861
## 2461   aug sun        rain -0.0726485861
## 2462   sep wed        rain -0.0726485861
## 2463   aug tue        rain -0.0726485861
## 2464   sep sun        rain -0.0726485861
## 2465   oct mon        rain -0.0726485861
## 2466   feb sun        rain -0.0726485861
## 2467   oct mon        rain -0.0726485861
## 2468   aug fri        rain -0.0726485861
## 2469   sep tue        rain -0.0726485861
## 2470   mar sun        rain -0.0726485861
## 2471   sep mon        rain -0.0726485861
## 2472   mar sat        rain -0.0726485861
## 2473   mar sun        rain -0.0726485861
## 2474   mar fri        rain -0.0726485861
## 2475   aug thu        rain -0.0726485861
## 2476   aug tue        rain -0.0726485861
## 2477   sep wed        rain -0.0726485861
## 2478   aug tue        rain -0.0726485861
## 2479   aug fri        rain -0.0726485861
## 2480   apr thu        rain -0.0726485861
## 2481   sep thu        rain -0.0726485861
## 2482   sep tue        rain -0.0726485861
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## 2483   sep mon        rain -0.0726485861
## 2484   sep tue        rain -0.0726485861
## 2485   mar sun        rain -0.0726485861
## 2486   feb sun        rain -0.0726485861
## 2487   oct wed        rain -0.0726485861
## 2488   mar sat        rain -0.0726485861
## 2489   sep thu        rain -0.0726485861
## 2490   aug sat        rain -0.0726485861
## 2491   sep tue        rain -0.0726485861
## 2492   sep fri        rain -0.0726485861
## 2493   sep thu        rain -0.0726485861
## 2494   oct sat        rain -0.0726485861
## 2495   aug sat        rain -0.0726485861
## 2496   sep fri        rain -0.0726485861
## 2497   mar mon        rain -0.0726485861
## 2498   mar sat        rain -0.0726485861
## 2499   mar sat        rain -0.0726485861
## 2500   sep sun        rain -0.0726485861
## 2501   sep mon        rain -0.0726485861
## 2502   sep wed        rain -0.0726485861
## 2503   mar mon        rain -0.0726485861
## 2504   aug sun        rain -0.0726485861
## 2505   sep fri        rain -0.0726485861
## 2506   mar mon        rain -0.0726485861
## 2507   jul fri        rain -0.0726485861
## 2508   sep wed        rain -0.0726485861
## 2509   sep sun        rain -0.0726485861
## 2510   oct mon        rain -0.0726485861
## 2511   aug sat        rain -0.0726485861
## 2512   sep sun        rain -0.0726485861
## 2513   aug sat        rain -0.0726485861
## 2514   sep wed        rain -0.0726485861
## 2515   sep sun        rain -0.0726485861
## 2516   sep tue        rain -0.0726485861
## 2517   sep tue        rain -0.0726485861
## 2518   sep sat        rain -0.0726485861
## 2519   aug sun        rain -0.0726485861
## 2520   sep sat        rain -0.0726485861
## 2521   sep tue        rain -0.0726485861
## 2522   sep sat        rain -0.0726485861
## 2523   aug sun        rain -0.0726485861
## 2524   aug sun        rain -0.0726485861
## 2525   aug sun        rain -0.0726485861
## 2526   aug wed        rain -0.0726485861
## 2527   aug wed        rain -0.0726485861
## 2528   aug wed        rain -0.0726485861
## 2529   aug wed        rain -0.0726485861
## 2530   aug wed        rain -0.0726485861
## 2531   aug thu        rain -0.0726485861
## 2532   aug thu        rain -0.0726485861
## 2533   aug sat        rain -0.0726485861
## 2534   aug sat        rain -0.0726485861
## 2535   aug sat        rain -0.0726485861
## 2536   aug mon        rain -0.0726485861
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## 2537   aug fri        rain -0.0726485861
## 2538   aug fri        rain -0.0726485861
## 2539   aug fri        rain -0.0726485861
## 2540   aug fri        rain -0.0726485861
## 2541   aug tue        rain -0.0726485861
## 2542   aug tue        rain -0.0726485861
## 2543   aug tue        rain -0.0726485861
## 2544   aug tue        rain -0.0726485861
## 2545   aug tue        rain -0.0726485861
## 2546   aug tue        rain -0.0726485861
## 2547   dec sun        rain -0.0726485861
## 2548   dec wed        rain -0.0726485861
## 2549   dec thu        rain -0.0726485861
## 2550   dec mon        rain -0.0726485861
## 2551   dec mon        rain -0.0726485861
## 2552   dec mon        rain -0.0726485861
## 2553   dec mon        rain -0.0726485861
## 2554   dec fri        rain -0.0726485861
## 2555   dec tue        rain -0.0726485861
## 2556   feb wed        rain -0.0726485861
## 2557   feb fri        rain -0.0726485861
## 2558   jul sat        rain -0.0726485861
## 2559   jul fri        rain -0.0726485861
## 2560   jul tue        rain -0.0726485861
## 2561   jul tue        rain -0.0726485861
## 2562   jun sun        rain -0.0726485861
## 2563   jun mon        rain -0.0726485861
## 2564   sep sun        rain -0.0726485861
## 2565   sep sun        rain -0.0726485861
## 2566   sep sun        rain -0.0726485861
## 2567   sep wed        rain -0.0726485861
## 2568   sep thu        rain -0.0726485861
## 2569   sep thu        rain -0.0726485861
## 2570   sep thu        rain -0.0726485861
## 2571   sep thu        rain -0.0726485861
## 2572   sep thu        rain -0.0726485861
## 2573   sep thu        rain -0.0726485861
## 2574   sep thu        rain -0.0726485861
## 2575   sep sat        rain -0.0726485861
## 2576   sep sat        rain -0.0726485861
## 2577   sep sat        rain -0.0726485861
## 2578   sep sat        rain -0.0726485861
## 2579   sep mon        rain -0.0726485861
## 2580   sep mon        rain -0.0726485861
## 2581   sep mon        rain -0.0726485861
## 2582   sep mon        rain -0.0726485861
## 2583   sep mon        rain -0.0726485861
## 2584   sep mon        rain -0.0726485861
## 2585   sep mon        rain -0.0726485861
## 2586   sep mon        rain -0.0726485861
## 2587   sep mon        rain -0.0726485861
## 2588   sep fri        rain -0.0726485861
## 2589   sep fri        rain -0.0726485861
## 2590   sep fri        rain -0.0726485861
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## 2591   sep fri        rain -0.0726485861
## 2592   sep fri        rain -0.0726485861
## 2593   sep fri        rain -0.0726485861
## 2594   sep fri        rain -0.0726485861
## 2595   sep fri        rain -0.0726485861
## 2596   sep fri        rain -0.0726485861
## 2597   sep fri        rain -0.0726485861
## 2598   sep fri        rain -0.0726485861
## 2599   sep fri        rain -0.0726485861
## 2600   sep tue        rain -0.0726485861
## 2601   sep tue        rain -0.0726485861
## 2602   sep tue        rain -0.0726485861
## 2603   sep tue        rain -0.0726485861
## 2604   sep sat        rain -0.0726485861
## 2605   sep sun        rain -0.0726485861
## 2606   sep fri        rain -0.0726485861
## 2607   sep sat        rain -0.0726485861
## 2608   aug sat        rain -0.0726485861
## 2609   jul wed        rain -0.0726485861
## 2610   aug thu        rain -0.0726485861
## 2611   aug wed        rain -0.0726485861
## 2612   aug thu        rain -0.0726485861
## 2613   aug sat        rain -0.0726485861
## 2614   aug sun        rain -0.0726485861
## 2615   sep sun        rain -0.0726485861
## 2616   aug fri        rain -0.0726485861
## 2617   feb mon        rain -0.0726485861
## 2618   sep fri        rain -0.0726485861
## 2619   sep sun        rain -0.0726485861
## 2620   feb sun        rain -0.0726485861
## 2621   sep sun        rain -0.0726485861
## 2622   aug sun        rain -0.0726485861
## 2623   jun wed        rain -0.0726485861
## 2624   sep thu        rain -0.0726485861
## 2625   sep wed        rain -0.0726485861
## 2626   sep sat        rain -0.0726485861
## 2627   sep fri        rain -0.0726485861
## 2628   feb fri        rain -0.0726485861
## 2629   jul mon        rain -0.0726485861
## 2630   aug thu        rain -0.0726485861
## 2631   jul tue        rain -0.0726485861
## 2632   aug sun        rain -0.0726485861
## 2633   aug sun        rain -0.0726485861
## 2634   aug wed        rain -0.0726485861
## 2635   jul sun        rain -0.0726485861
## 2636   sep sat        rain -0.0726485861
## 2637   aug sat        rain -0.0726485861
## 2638   aug mon        rain -0.0726485861
## 2639   aug sun        rain -0.0726485861
## 2640   aug sat        rain -0.0726485861
## 2641   aug sun        rain -0.0726485861
## 2642   aug mon        rain -0.0726485861
## 2643   aug sat        rain -0.0726485861
## 2644   sep fri        rain -0.0726485861
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## 2645   aug mon        rain -0.0726485861
## 2646   apr mon        rain -0.0726485861
## 2647   sep fri        rain -0.0726485861
## 2648   aug wed        rain -0.0726485861
## 2649   aug fri        rain -0.0726485861
## 2650   aug wed        rain -0.0726485861
## 2651   aug sat        rain -0.0726485861
## 2652   aug sat        rain -0.0726485861
## 2653   sep sun        rain -0.0726485861
## 2654   feb tue        rain -0.0726485861
## 2655   feb tue        rain -0.0726485861
## 2656   feb sat        rain -0.0726485861
## 2657   mar mon        rain -0.0726485861
## 2658   mar wed        rain -0.0726485861
## 2659   mar thu        rain -0.0726485861
## 2660   apr sun        rain -0.0726485861
## 2661   may fri        rain -0.0726485861
## 2662   jun mon        rain -0.0726485861
## 2663   jun sat        rain -0.0726485861
## 2664   jun thu        rain -0.0726485861
## 2665   jun thu        rain -0.0726485861
## 2666   jul thu        rain -0.0726485861
## 2667   jul sun        rain -0.0726485861
## 2668   jul sun        rain -0.0726485861
## 2669   jul mon        rain -0.0726485861
## 2670   jul thu        rain -0.0726485861
## 2671   aug sun        rain -0.0726485861
## 2672   aug sun        rain -0.0726485861
## 2673   aug mon        rain -0.0726485861
## 2674   aug tue        rain -0.0726485861
## 2675   aug tue        rain -0.0726485861
## 2676   aug tue        rain -0.0726485861
## 2677   aug fri        rain -0.0726485861
## 2678   aug sat        rain -0.0726485861
## 2679   aug mon        rain -0.0726485861
## 2680   aug tue        rain -0.0726485861
## 2681   aug tue        rain -0.0726485861
## 2682   aug tue        rain 15.9621983217
## 2683   aug wed        rain -0.0726485861
## 2684   aug wed        rain -0.0726485861
## 2685   aug thu        rain -0.0726485861
## 2686   aug fri        rain  3.4349741750
## 2687   aug fri        rain -0.0726485861
## 2688   aug sun        rain -0.0726485861
## 2689   aug sun        rain -0.0726485861
## 2690   aug sun        rain -0.0726485861
## 2691   jul tue        area -0.2808001513
## 2692   sep tue        area -0.2799923026
## 2693   sep mon        area -0.2795306747
## 2694   aug wed        area -0.2786074191
## 2695   aug fri        area -0.2779149773
## 2696   jul sat        area -0.2767609077
## 2697   aug wed        area -0.2760684659
## 2698   aug thu        area -0.2745681754
```

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## 2699   mar mon        area -0.2739911406
## 2700   sep tue        area -0.2738757337
## 2701   aug tue        area -0.2726062571
## 2702   sep thu        area -0.2720292223
## 2703   jun fri        area -0.2712213736
## 2704   jul sun        area -0.2692594552
## 2705   jul sat        area -0.2684516065
## 2706   sep fri        area -0.2681053856
## 2707   sep sat        area -0.2681053856
## 2708   aug sun        area -0.2669513160
## 2709   sep sat        area -0.2663742812
## 2710   aug wed        area -0.2661434673
## 2711   aug wed        area -0.2660280603
## 2712   sep fri        area -0.2654510255
## 2713   mar mon        area -0.2647585838
## 2714   aug thu        area -0.2630274794
## 2715   mar sat        area -0.2625658515
## 2716   sep sat        area -0.2624504446
## 2717   sep sun        area -0.2617580028
## 2718   mar thu        area -0.2602577123
## 2719   aug wed        area -0.2585266079
## 2720   aug wed        area -0.2559876547
## 2721   mar fri        area -0.2557568408
## 2722   aug thu        area -0.2555260269
## 2723   sep wed        area -0.2552952130
## 2724   aug wed        area -0.2539103295
## 2725   aug sun        area -0.2533332947
## 2726   sep mon        area -0.2495248649
## 2727   aug sat        area -0.2445623656
## 2728   aug sat        area -0.2326754487
## 2729   apr thu        area -0.2317521930
## 2730   aug sun        area -0.2308289373
## 2731   sep wed        area -0.2286362050
## 2732   aug tue        area -0.2245969614
## 2733   sep sun        area -0.2234428918
## 2734   oct mon        area -0.2221734152
## 2735   feb sun        area -0.2113251609
## 2736   oct mon        area -0.2061318477
## 2737   aug fri        area -0.2046315572
## 2738   sep tue        area -0.2037083015
## 2739   mar sun        area -0.2019771971
## 2740   sep mon        area -0.2007077205
## 2741   mar sat        area -0.1995536509
## 2742   mar sun        area -0.1898594662
## 2743   mar fri        area -0.1890516175
## 2744   aug thu        area -0.1847815600
## 2745   aug tue        area -0.1844353391
## 2746   sep wed        area -0.1763568518
## 2747   aug tue        area -0.1694324342
## 2748   aug fri        area -0.1693170272
## 2749   apr thu        area -0.1588149938
## 2750   sep thu        area -0.1573147033
## 2751   sep tue        area -0.1552373780
## 2752   sep mon        area -0.1543141223
```

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## 2753   sep tue        area -0.1518905761
## 2754   mar sun        area -0.1453123794
## 2755   feb sun        area -0.1343487181
## 2756   oct wed        area -0.1268472657
## 2757   mar sat        area -0.1235004638
## 2758   sep thu        area -0.1168068601
## 2759   aug sat        area -0.1066510475
## 2760   sep tue        area -0.0864548294
## 2761   sep fri        area -0.0630272164
## 2762   sep thu        area -0.0147871068
## 2763   oct sat        area -0.0053237360
## 2764   aug sat        area  0.0151032961
## 2765   sep fri        area  0.0166035866
## 2766   mar mon        area  0.0306832358
## 2767   mar sat        area  0.0458015476
## 2768   mar sat        area  0.0458015476
## 2769   sep sun        area  0.0552649184
## 2770   sep mon        area  0.0649591031
## 2771   sep wed        area  0.0811160776
## 2772   mar mon        area  0.0827317751
## 2773   aug sun        area  0.0851553213
## 2774   sep fri        area  0.1291253733
## 2775   mar mon        area  0.1403198485
## 2776   jul fri        area  0.1422817668
## 2777   sep wed        area  0.1502448471
## 2778   sep sun        area  0.2753459926
## 2779   oct mon        area  0.2848093634
## 2780   aug sat        area  0.3878677794
## 2781   sep sun        area  0.4548038166
## 2782   aug sat        area  0.5378968283
## 2783   sep wed        area  0.7362813939
## 2784   sep sun        area  0.8134886506
## 2785   sep tue        area  0.9082377654
## 2786   sep tue        area  0.9344351455
## 2787   sep sat        area  1.5024682064
## 2788   aug sun        area  1.9825611632
## 2789   sep sat        area  2.0340326677
## 2790   sep tue        area  2.1718285788
## 2791   sep sat        area 12.3040981060
## 2792   aug sun        area -0.1680475506
## 2793   aug sun        area -0.2518330042
## 2794   aug sun        area -0.2761838729
## 2795   aug wed        area -0.2762992798
## 2796   aug wed        area -0.2564492826
## 2797   aug wed        area -0.2771071286
## 2798   aug wed        area -0.2821850348
## 2799   aug wed        area -0.2825312557
## 2800   aug thu        area -0.2674129439
## 2801   aug thu        area -0.1656240045
## 2802   aug sat        area -0.1923984194
## 2803   aug sat        area -0.2771071286
## 2804   aug sat        area -0.2690286413
## 2805   aug mon        area -0.1828196416
## 2806   aug fri        area -0.2468705048
```

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## 2807   aug fri        area -0.2359068436
## 2808   aug fri        area -0.2669513160
## 2809   aug fri        area -0.2094786496
## 2810   aug tue        area -0.2758376520
## 2811   aug tue        area -0.2829928836
## 2812   aug tue        area -0.2341757392
## 2813   aug tue        area -0.2789536399
## 2814   aug tue        area -0.1779725493
## 2815   aug tue        area -0.2492940510
## 2816   dec sun        area -0.1813193511
## 2817   dec wed        area -0.1558144128
## 2818   dec thu        area -0.2228658570
## 2819   dec mon        area -0.0789533769
## 2820   dec mon        area -0.1611231330
## 2821   dec mon        area -0.0307132673
## 2822   dec mon        area -0.1722022012
## 2823   dec fri        area -0.1779725493
## 2824   dec tue        area  0.0009082399
## 2825   feb wed        area -0.2722600362
## 2826   feb fri        area -0.0052083290
## 2827   jul sat        area -0.1926292333
## 2828   jul fri        area -0.2544873643
## 2829   jul tue        area  0.7127383739
## 2830   jul tue        area -0.2091324287
## 2831   jun sun        area -0.2745681754
## 2832   jun mon        area -0.2443315517
## 2833   sep sun        area -0.2802231165
## 2834   sep sun        area -0.2251739962
## 2835   sep sun        area -0.1200382550
## 2836   sep wed        area -0.2667205021
## 2837   sep thu        area -0.2413309707
## 2838   sep thu        area -0.2340603322
## 2839   sep thu        area  0.1115835153
## 2840   sep thu        area -0.2017463832
## 2841   sep thu        area -0.2732986989
## 2842   sep thu        area -0.2597960845
## 2843   sep thu        area -0.2339449252
## 2844   sep sat        area -0.2465242840
## 2845   sep sat        area -0.2090170217
## 2846   sep sat        area -0.1044583153
## 2847   sep sat        area -0.1554681919
## 2848   sep mon        area -0.2603731193
## 2849   sep mon        area  0.3617858062
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## 2852   sep mon        area -0.2395998663
## 2853   sep mon        area -0.2597960845
## 2854   sep mon        area -0.2145565558
## 2855   sep mon        area -0.2176725438
## 2856   sep mon        area  0.0403774205
## 2857   sep fri        area -0.2660280603
## 2858   sep fri        area -0.2421388195
## 2859   sep fri        area -0.2005923136
## 2860   sep fri        area -0.2615271889
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## 2861   sep fri        area -0.2651048046
## 2862   sep fri        area -0.2160568463
## 2863   sep fri        area -0.1342333111
## 2864   sep fri        area -0.2704135248
## 2865   sep fri        area -0.1912443498
## 2866   sep fri        area -0.2723754432
## 2867   sep fri        area -0.2394844594
## 2868   sep fri        area -0.2789536399
## 2869   sep tue        area -0.2511405624
## 2870   sep tue        area -0.2197498691
## 2871   sep tue        area -0.0537946595
## 2872   sep tue        area -0.2647585838
## 2873   sep sat        area -0.1390804035
## 2874   sep sun        area -0.1573147033
## 2875   sep fri        area -0.0737600637
## 2876   sep sat        area  0.1691715887
## 2877   aug sat        area  1.7303969539
## 2878   jul wed        area -0.1957452212
## 2879   aug thu        area -0.0964952350
## 2880   aug wed        area -0.2173263229
## 2881   aug thu        area  0.2097948389
## 2882   aug sat        area -0.1443891237
## 2883   aug sun        area -0.1003036647
## 2884   sep sun        area -0.0011690854
## 2885   aug fri        area  0.0467248033
## 2886   feb mon        area -0.1700094690
## 2887   sep fri        area  0.0633434057
## 2888   sep sun        area  0.5316648525
## 2889   feb sun        area  0.3126224409
## 2890   sep sun        area -0.2429466682
## 2891   aug sun        area -0.2430620751
## 2892   jun wed        area -0.1907827219
## 2893   sep thu        area -0.2278283563
## 2894   sep wed        area -0.2152489976
## 2895   sep sat        area -0.2393690524
## 2896   sep fri        area -0.1949373725
## 2897   feb fri        area -0.2316367860
## 2898   jul mon        area -0.2661434673
## 2899   aug thu        area  8.3276358660
## 2900   jul tue        area -0.2039391154
## 2901   aug sun        area -0.2567955035
## 2902   aug sun        area -0.2497556789
## 2903   aug wed        area  1.8588449012
## 2904   jul sun        area -0.2122484166
## 2905   sep sat        area -0.2766455007
## 2906   aug sat        area -0.2277129494
## 2907   aug mon        area -0.2578341661
## 2908   aug sun        area -0.2480245745
## 2909   aug sat        area -0.2115559749
## 2910   aug sun        area -0.1079205241
## 2911   aug mon        area -0.2787228260
## 2912   aug sat        area -0.2107481261
## 2913   sep fri        area -0.2811463722
## 2914   aug mon        area -0.2707597457
```

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## 2915   apr mon        area -0.2462934700
## 2916   sep fri        area -0.1700094690
## 2917   aug wed        area -0.2107481261
## 2918   aug fri        area -0.1728946430
## 2919   aug wed        area  0.6700377984
## 2920   aug sat        area -0.2466396909
## 2921   aug sat        area -0.2625658515
## 2922   sep sun        area -0.2421388195
## 2923   feb tue        area -0.2227504500
## 2924   feb tue        area -0.2602577123
## 2925   feb sat        area -0.2060164407
## 2926   mar mon        area -0.2482553884
## 2927   mar wed        area -0.2209039387
## 2928   mar thu        area -0.2086708008
## 2929   apr sun        area  0.4205279492
## 2930   may fri        area  0.1591311831
## 2931   jun mon        area -0.2625658515
## 2932   jun sat        area  0.5265869462
## 2933   jun thu        area -0.1686245855
## 2934   jun thu        area -0.2481399814
## 2935   jul thu        area -0.2646431768
## 2936   jul sun        area -0.2000152788
## 2937   jul sun        area -0.2594498636
## 2938   jul mon        area  2.9294752763
## 2939   jul thu        area -0.2532178877
## 2940   aug sun        area -0.2700673040
## 2941   aug sun        area  0.0200657954
## 2942   aug mon        area -0.2610655610
## 2943   aug tue        area -0.2618734097
## 2944   aug tue        area -0.0956873862
## 2945   aug tue        area  0.2539957049
## 2946   aug fri        area  0.2149881521
## 2947   aug sat        area -0.1858202226
## 2948   aug mon        area -0.2529870738
## 2949   aug tue        area -0.1155373835
## 2950   aug tue        area  0.1829050170
## 2951   aug tue        area -0.1600844704
## 2952   aug wed        area -0.2624504446
## 2953   aug wed        area  0.2873483165
## 2954   aug thu        area -0.2180187647
## 2955   aug fri        area -0.2599114914
## 2956   aug fri        area -0.2799923026
## 2957   aug sun        area -0.2106327192
## 2958   aug sun        area  0.3415895881
## 2959   aug sun        area -0.1561606337
## 2960   jul tue fire_yes_no  1.0000000000
## 2961   sep tue fire_yes_no  1.0000000000
## 2962   sep mon fire_yes_no  1.0000000000
## 2963   aug wed fire_yes_no  1.0000000000
## 2964   aug fri fire_yes_no  1.0000000000
## 2965   jul sat fire_yes_no  1.0000000000
## 2966   aug wed fire_yes_no  1.0000000000
## 2967   aug thu fire_yes_no  1.0000000000
## 2968   mar mon fire_yes_no  1.0000000000
```

```
## 2969   sep tue fire_yes_no  1.0000000000
## 2970   aug tue fire_yes_no  1.0000000000
## 2971   sep thu fire_yes_no  1.0000000000
## 2972   jun fri fire_yes_no  1.0000000000
## 2973   jul sun fire_yes_no  1.0000000000
## 2974   jul sat fire_yes_no  1.0000000000
## 2975   sep fri fire_yes_no  1.0000000000
## 2976   sep sat fire_yes_no  1.0000000000
## 2977   aug sun fire_yes_no  1.0000000000
## 2978   sep sat fire_yes_no  1.0000000000
## 2979   aug wed fire_yes_no  1.0000000000
## 2980   aug wed fire_yes_no  1.0000000000
## 2981   sep fri fire_yes_no  1.0000000000
## 2982   mar mon fire_yes_no  1.0000000000
## 2983   aug thu fire_yes_no  1.0000000000
## 2984   mar sat fire_yes_no  1.0000000000
## 2985   sep sat fire_yes_no  1.0000000000
## 2986   sep sun fire_yes_no  1.0000000000
## 2987   mar thu fire_yes_no  1.0000000000
## 2988   aug wed fire_yes_no  1.0000000000
## 2989   aug wed fire_yes_no  1.0000000000
## 2990   mar fri fire_yes_no  1.0000000000
## 2991   aug thu fire_yes_no  1.0000000000
## 2992   sep wed fire_yes_no  1.0000000000
## 2993   aug wed fire_yes_no  1.0000000000
## 2994   aug sun fire_yes_no  1.0000000000
## 2995   sep mon fire_yes_no  1.0000000000
## 2996   aug sat fire_yes_no  1.0000000000
## 2997   aug sat fire_yes_no  1.0000000000
## 2998   apr thu fire_yes_no  1.0000000000
## 2999   aug sun fire_yes_no  1.0000000000
## 3000   sep wed fire_yes_no  1.0000000000
## 3001   aug tue fire_yes_no  1.0000000000
## 3002   sep sun fire_yes_no  1.0000000000
## 3003   oct mon fire_yes_no  1.0000000000
## 3004   feb sun fire_yes_no  1.0000000000
## 3005   oct mon fire_yes_no  1.0000000000
## 3006   aug fri fire_yes_no  1.0000000000
## 3007   sep tue fire_yes_no  1.0000000000
## 3008   mar sun fire_yes_no  1.0000000000
## 3009   sep mon fire_yes_no  1.0000000000
## 3010   mar sat fire_yes_no  1.0000000000
## 3011   mar sun fire_yes_no  1.0000000000
## 3012   mar fri fire_yes_no  1.0000000000
## 3013   aug thu fire_yes_no  1.0000000000
## 3014   aug tue fire_yes_no  1.0000000000
## 3015   sep wed fire_yes_no  1.0000000000
## 3016   aug tue fire_yes_no  1.0000000000
## 3017   aug fri fire_yes_no  1.0000000000
## 3018   apr thu fire_yes_no  1.0000000000
## 3019   sep thu fire_yes_no  1.0000000000
## 3020   sep tue fire_yes_no  1.0000000000
## 3021   sep mon fire_yes_no  1.0000000000
## 3022   sep tue fire_yes_no  1.0000000000
```

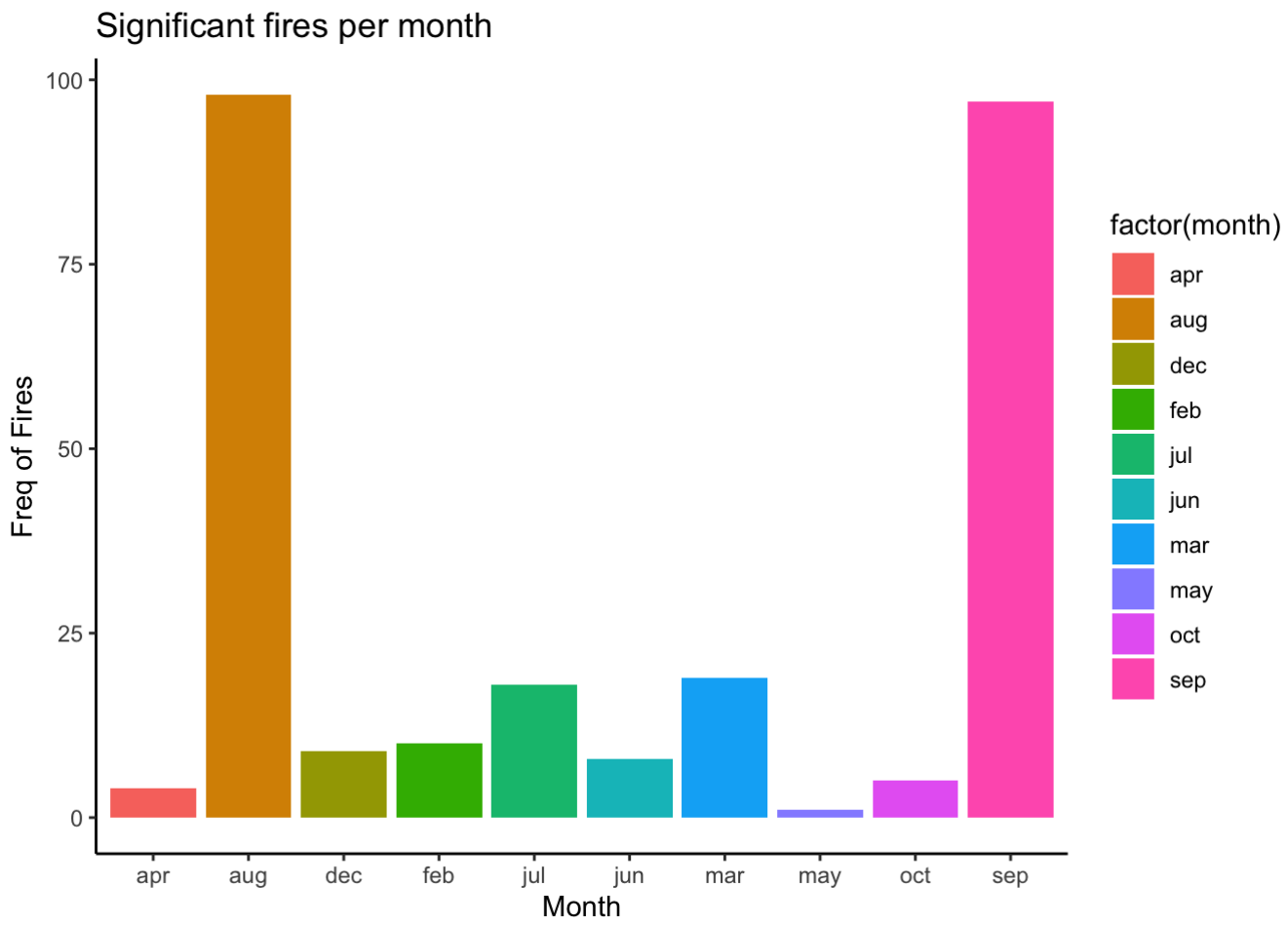
```
## 3023   mar sun fire_yes_no  1.0000000000
## 3024   feb sun fire_yes_no  1.0000000000
## 3025   oct wed fire_yes_no  1.0000000000
## 3026   mar sat fire_yes_no  1.0000000000
## 3027   sep thu fire_yes_no  1.0000000000
## 3028   aug sat fire_yes_no  1.0000000000
## 3029   sep tue fire_yes_no  1.0000000000
## 3030   sep fri fire_yes_no  1.0000000000
## 3031   sep thu fire_yes_no  1.0000000000
## 3032   oct sat fire_yes_no  1.0000000000
## 3033   aug sat fire_yes_no  1.0000000000
## 3034   sep fri fire_yes_no  1.0000000000
## 3035   mar mon fire_yes_no  1.0000000000
## 3036   mar sat fire_yes_no  1.0000000000
## 3037   mar sat fire_yes_no  1.0000000000
## 3038   sep sun fire_yes_no  1.0000000000
## 3039   sep mon fire_yes_no  1.0000000000
## 3040   sep wed fire_yes_no  1.0000000000
## 3041   mar mon fire_yes_no  1.0000000000
## 3042   aug sun fire_yes_no  1.0000000000
## 3043   sep fri fire_yes_no  1.0000000000
## 3044   mar mon fire_yes_no  1.0000000000
## 3045   jul fri fire_yes_no  1.0000000000
## 3046   sep wed fire_yes_no  1.0000000000
## 3047   sep sun fire_yes_no  1.0000000000
## 3048   oct mon fire_yes_no  1.0000000000
## 3049   aug sat fire_yes_no  1.0000000000
## 3050   sep sun fire_yes_no  1.0000000000
## 3051   aug sat fire_yes_no  1.0000000000
## 3052   sep wed fire_yes_no  1.0000000000
## 3053   sep sun fire_yes_no  1.0000000000
## 3054   sep tue fire_yes_no  1.0000000000
## 3055   sep tue fire_yes_no  1.0000000000
## 3056   sep sat fire_yes_no  1.0000000000
## 3057   aug sun fire_yes_no  1.0000000000
## 3058   sep sat fire_yes_no  1.0000000000
## 3059   sep tue fire_yes_no  1.0000000000
## 3060   sep sat fire_yes_no  1.0000000000
## 3061   aug sun fire_yes_no  1.0000000000
## 3062   aug sun fire_yes_no  1.0000000000
## 3063   aug sun fire_yes_no  1.0000000000
## 3064   aug wed fire_yes_no  1.0000000000
## 3065   aug wed fire_yes_no  1.0000000000
## 3066   aug wed fire_yes_no  1.0000000000
## 3067   aug wed fire_yes_no  1.0000000000
## 3068   aug wed fire_yes_no  1.0000000000
## 3069   aug thu fire_yes_no  1.0000000000
## 3070   aug thu fire_yes_no  1.0000000000
## 3071   aug sat fire_yes_no  1.0000000000
## 3072   aug sat fire_yes_no  1.0000000000
## 3073   aug sat fire_yes_no  1.0000000000
## 3074   aug mon fire_yes_no  1.0000000000
## 3075   aug fri fire_yes_no  1.0000000000
## 3076   aug fri fire_yes_no  1.0000000000
```

```
## 3077   aug fri fire_yes_no  1.0000000000
## 3078   aug fri fire_yes_no  1.0000000000
## 3079   aug tue fire_yes_no  1.0000000000
## 3080   aug tue fire_yes_no  1.0000000000
## 3081   aug tue fire_yes_no  1.0000000000
## 3082   aug tue fire_yes_no  1.0000000000
## 3083   aug tue fire_yes_no  1.0000000000
## 3084   aug tue fire_yes_no  1.0000000000
## 3085   dec sun fire_yes_no  1.0000000000
## 3086   dec wed fire_yes_no  1.0000000000
## 3087   dec thu fire_yes_no  1.0000000000
## 3088   dec mon fire_yes_no  1.0000000000
## 3089   dec mon fire_yes_no  1.0000000000
## 3090   dec mon fire_yes_no  1.0000000000
## 3091   dec mon fire_yes_no  1.0000000000
## 3092   dec fri fire_yes_no  1.0000000000
## 3093   dec tue fire_yes_no  1.0000000000
## 3094   feb wed fire_yes_no  1.0000000000
## 3095   feb fri fire_yes_no  1.0000000000
## 3096   jul sat fire_yes_no  1.0000000000
## 3097   jul fri fire_yes_no  1.0000000000
## 3098   jul tue fire_yes_no  1.0000000000
## 3099   jul tue fire_yes_no  1.0000000000
## 3100   jun sun fire_yes_no  1.0000000000
## 3101   jun mon fire_yes_no  1.0000000000
## 3102   sep sun fire_yes_no  1.0000000000
## 3103   sep sun fire_yes_no  1.0000000000
## 3104   sep sun fire_yes_no  1.0000000000
## 3105   sep wed fire_yes_no  1.0000000000
## 3106   sep thu fire_yes_no  1.0000000000
## 3107   sep thu fire_yes_no  1.0000000000
## 3108   sep thu fire_yes_no  1.0000000000
## 3109   sep thu fire_yes_no  1.0000000000
## 3110   sep thu fire_yes_no  1.0000000000
## 3111   sep thu fire_yes_no  1.0000000000
## 3112   sep thu fire_yes_no  1.0000000000
## 3113   sep sat fire_yes_no  1.0000000000
## 3114   sep sat fire_yes_no  1.0000000000
## 3115   sep sat fire_yes_no  1.0000000000
## 3116   sep sat fire_yes_no  1.0000000000
## 3117   sep mon fire_yes_no  1.0000000000
## 3118   sep mon fire_yes_no  1.0000000000
## 3119   sep mon fire_yes_no  1.0000000000
## 3120   sep mon fire_yes_no  1.0000000000
## 3121   sep mon fire_yes_no  1.0000000000
## 3122   sep mon fire_yes_no  1.0000000000
## 3123   sep mon fire_yes_no  1.0000000000
## 3124   sep mon fire_yes_no  1.0000000000
## 3125   sep mon fire_yes_no  1.0000000000
## 3126   sep fri fire_yes_no  1.0000000000
## 3127   sep fri fire_yes_no  1.0000000000
## 3128   sep fri fire_yes_no  1.0000000000
## 3129   sep fri fire_yes_no  1.0000000000
## 3130   sep fri fire_yes_no  1.0000000000
```

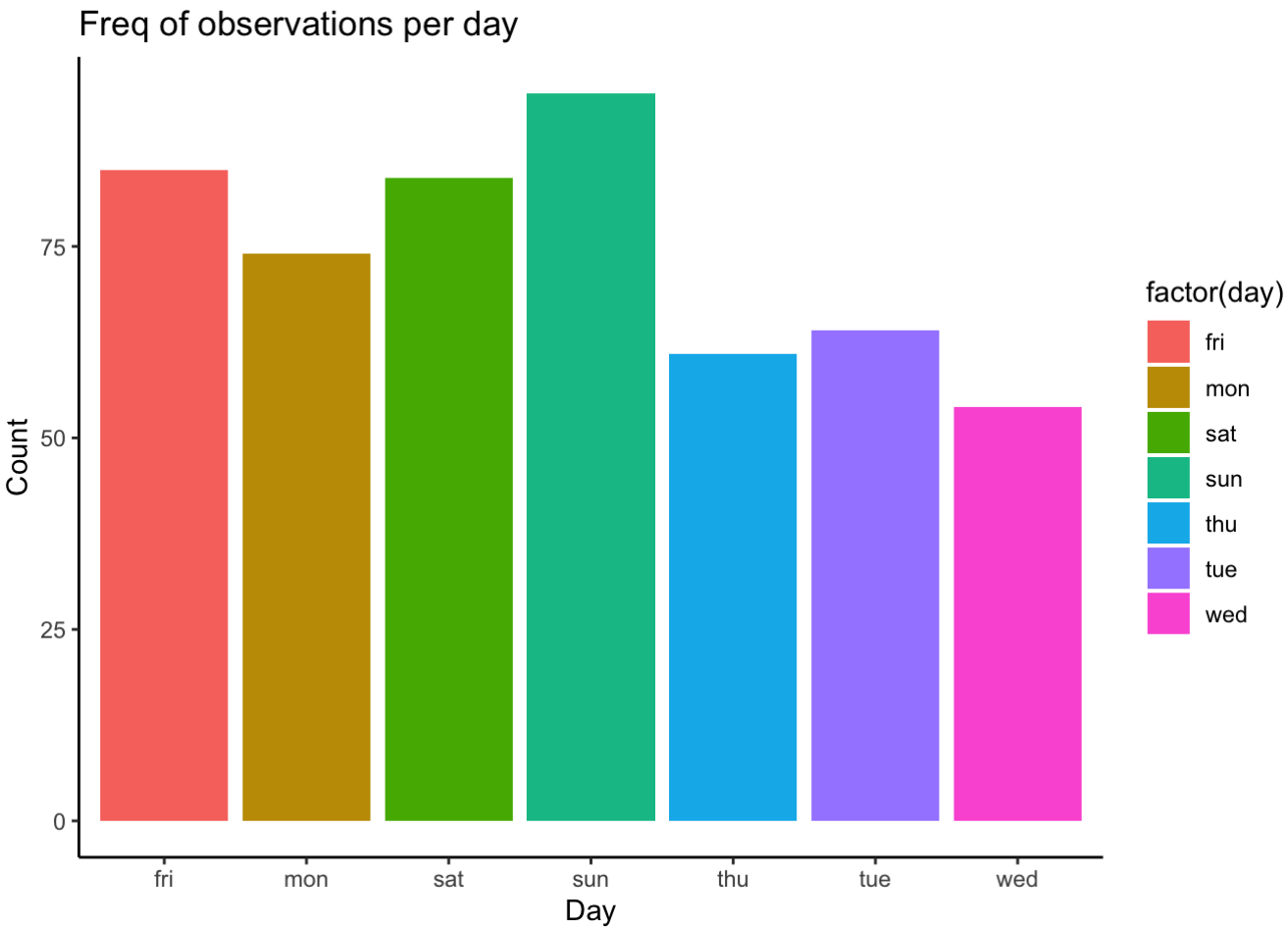
```
## 3131   sep fri fire_yes_no  1.0000000000
## 3132   sep fri fire_yes_no  1.0000000000
## 3133   sep fri fire_yes_no  1.0000000000
## 3134   sep fri fire_yes_no  1.0000000000
## 3135   sep fri fire_yes_no  1.0000000000
## 3136   sep fri fire_yes_no  1.0000000000
## 3137   sep fri fire_yes_no  1.0000000000
## 3138   sep tue fire_yes_no  1.0000000000
## 3139   sep tue fire_yes_no  1.0000000000
## 3140   sep tue fire_yes_no  1.0000000000
## 3141   sep tue fire_yes_no  1.0000000000
## 3142   sep sat fire_yes_no  1.0000000000
## 3143   sep sun fire_yes_no  1.0000000000
## 3144   sep fri fire_yes_no  1.0000000000
## 3145   sep sat fire_yes_no  1.0000000000
## 3146   aug sat fire_yes_no  1.0000000000
## 3147   jul wed fire_yes_no  1.0000000000
## 3148   aug thu fire_yes_no  1.0000000000
## 3149   aug wed fire_yes_no  1.0000000000
## 3150   aug thu fire_yes_no  1.0000000000
## 3151   aug sat fire_yes_no  1.0000000000
## 3152   aug sun fire_yes_no  1.0000000000
## 3153   sep sun fire_yes_no  1.0000000000
## 3154   aug fri fire_yes_no  1.0000000000
## 3155   feb mon fire_yes_no  1.0000000000
## 3156   sep fri fire_yes_no  1.0000000000
## 3157   sep sun fire_yes_no  1.0000000000
## 3158   feb sun fire_yes_no  1.0000000000
## 3159   sep sun fire_yes_no  1.0000000000
## 3160   aug sun fire_yes_no  1.0000000000
## 3161   jun wed fire_yes_no  1.0000000000
## 3162   sep thu fire_yes_no  1.0000000000
## 3163   sep wed fire_yes_no  1.0000000000
## 3164   sep sat fire_yes_no  1.0000000000
## 3165   sep fri fire_yes_no  1.0000000000
## 3166   feb fri fire_yes_no  1.0000000000
## 3167   jul mon fire_yes_no  1.0000000000
## 3168   aug thu fire_yes_no  1.0000000000
## 3169   jul tue fire_yes_no  1.0000000000
## 3170   aug sun fire_yes_no  1.0000000000
## 3171   aug sun fire_yes_no  1.0000000000
## 3172   aug wed fire_yes_no  1.0000000000
## 3173   jul sun fire_yes_no  1.0000000000
## 3174   sep sat fire_yes_no  1.0000000000
## 3175   aug sat fire_yes_no  1.0000000000
## 3176   aug mon fire_yes_no  1.0000000000
## 3177   aug sun fire_yes_no  1.0000000000
## 3178   aug sat fire_yes_no  1.0000000000
## 3179   aug sun fire_yes_no  1.0000000000
## 3180   aug mon fire_yes_no  1.0000000000
## 3181   aug sat fire_yes_no  1.0000000000
## 3182   sep fri fire_yes_no  1.0000000000
## 3183   aug mon fire_yes_no  1.0000000000
## 3184   apr mon fire_yes_no  1.0000000000
```

```
## 3185   sep fri fire_yes_no  1.0000000000
## 3186   aug wed fire_yes_no  1.0000000000
## 3187   aug fri fire_yes_no  1.0000000000
## 3188   aug wed fire_yes_no  1.0000000000
## 3189   aug sat fire_yes_no  1.0000000000
## 3190   aug sat fire_yes_no  1.0000000000
## 3191   sep sun fire_yes_no  1.0000000000
## 3192   feb tue fire_yes_no  1.0000000000
## 3193   feb tue fire_yes_no  1.0000000000
## 3194   feb sat fire_yes_no  1.0000000000
## 3195   mar mon fire_yes_no  1.0000000000
## 3196   mar wed fire_yes_no  1.0000000000
## 3197   mar thu fire_yes_no  1.0000000000
## 3198   apr sun fire_yes_no  1.0000000000
## 3199   may fri fire_yes_no  1.0000000000
## 3200   jun mon fire_yes_no  1.0000000000
## 3201   jun sat fire_yes_no  1.0000000000
## 3202   jun thu fire_yes_no  1.0000000000
## 3203   jun thu fire_yes_no  1.0000000000
## 3204   jul thu fire_yes_no  1.0000000000
## 3205   jul sun fire_yes_no  1.0000000000
## 3206   jul sun fire_yes_no  1.0000000000
## 3207   jul mon fire_yes_no  1.0000000000
## 3208   jul thu fire_yes_no  1.0000000000
## 3209   aug sun fire_yes_no  1.0000000000
## 3210   aug sun fire_yes_no  1.0000000000
## 3211   aug mon fire_yes_no  1.0000000000
## 3212   aug tue fire_yes_no  1.0000000000
## 3213   aug tue fire_yes_no  1.0000000000
## 3214   aug tue fire_yes_no  1.0000000000
## 3215   aug fri fire_yes_no  1.0000000000
## 3216   aug sat fire_yes_no  1.0000000000
## 3217   aug mon fire_yes_no  1.0000000000
## 3218   aug tue fire_yes_no  1.0000000000
## 3219   aug tue fire_yes_no  1.0000000000
## 3220   aug tue fire_yes_no  1.0000000000
## 3221   aug wed fire_yes_no  1.0000000000
## 3222   aug wed fire_yes_no  1.0000000000
## 3223   aug thu fire_yes_no  1.0000000000
## 3224   aug fri fire_yes_no  1.0000000000
## 3225   aug fri fire_yes_no  1.0000000000
## 3226   aug sun fire_yes_no  1.0000000000
## 3227   aug sun fire_yes_no  1.0000000000
## 3228   aug sun fire_yes_no  1.0000000000
```

```
# Vis of freq per month
g1 <- ggplot(forestfiresmm,aes(x=forestfiresmm$month,y=forestfiresmm$fire_yes_no))
g1 + geom_bar(stat = "identity",aes(fill=factor(month)))+labs(title = "Significant fires
per month")+xlab("Month")+ylab("Freq of Fires")+theme_classic()
```



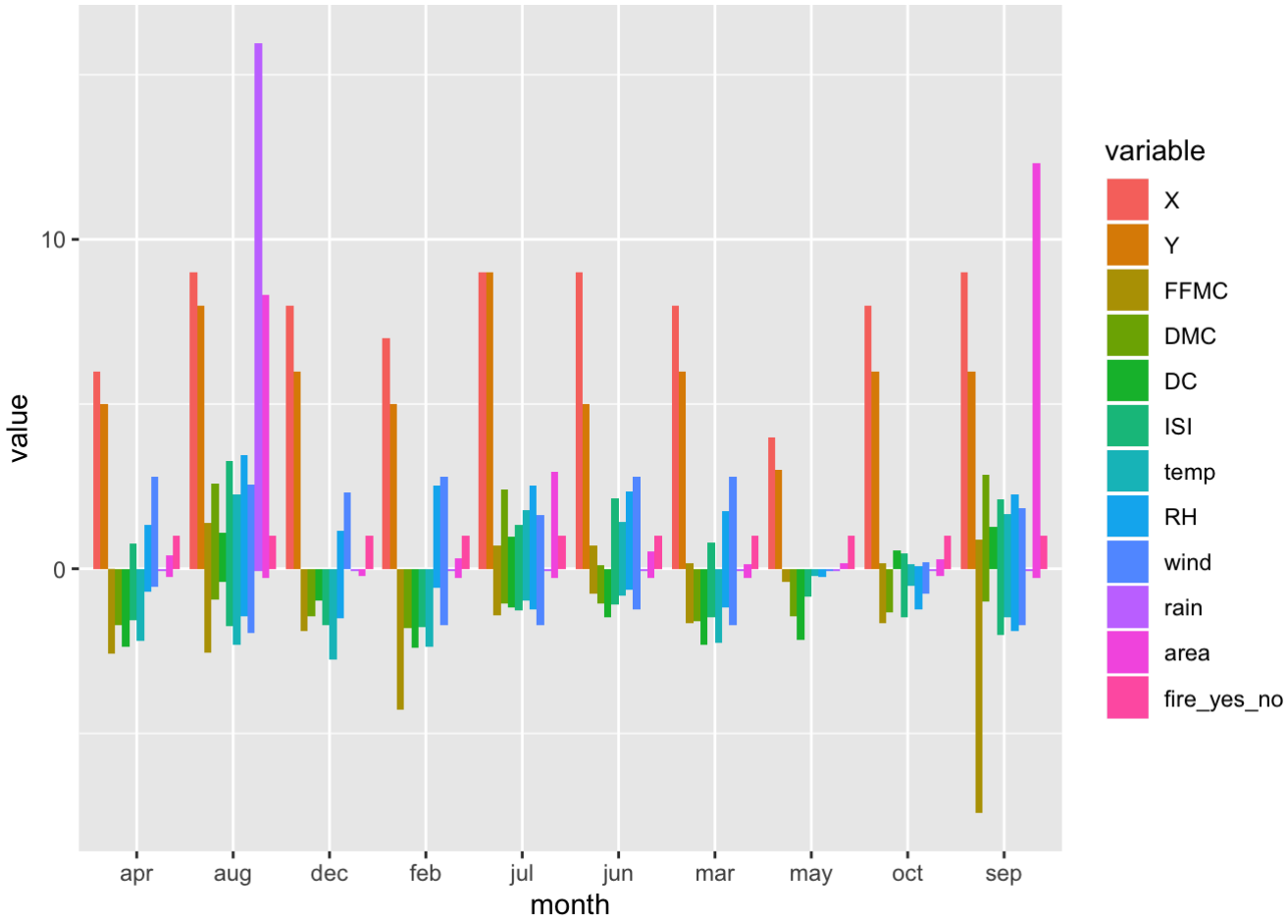

```
# Vis of freq per day
g2 <- ggplot(forestfires,aes(forestfires$day))
g2 + geom_bar(aes(fill=factor(day)))+labs(title = "Freq of observations per day")+xlab(
"Day")+ylab("Count")+theme_classic()
```



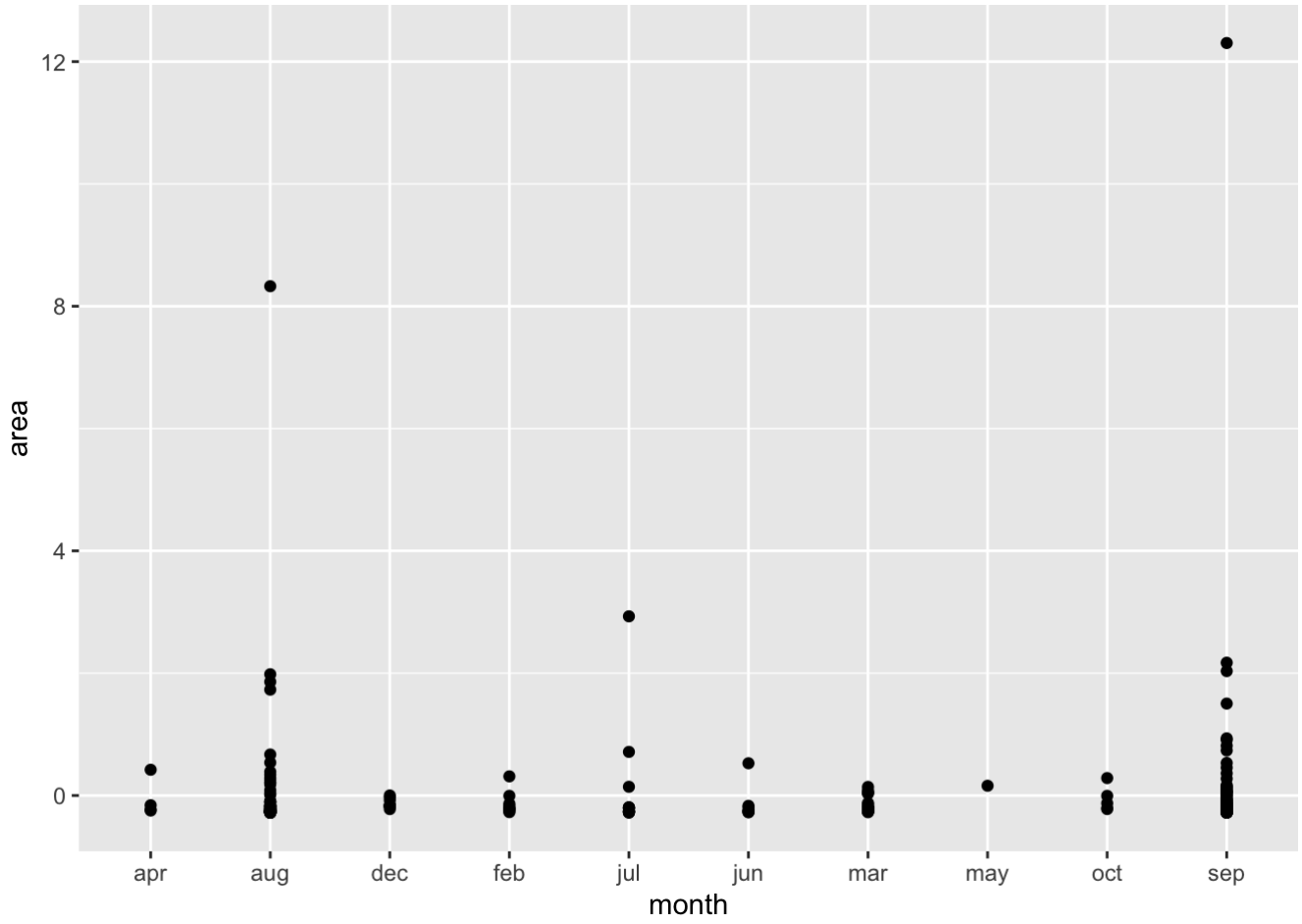

```
#install.packages("wesanderson") # this package has nice colors for graphs
#library(wesanderson)

mid <- mean(forestfires.scaled$area) # store the average value for area

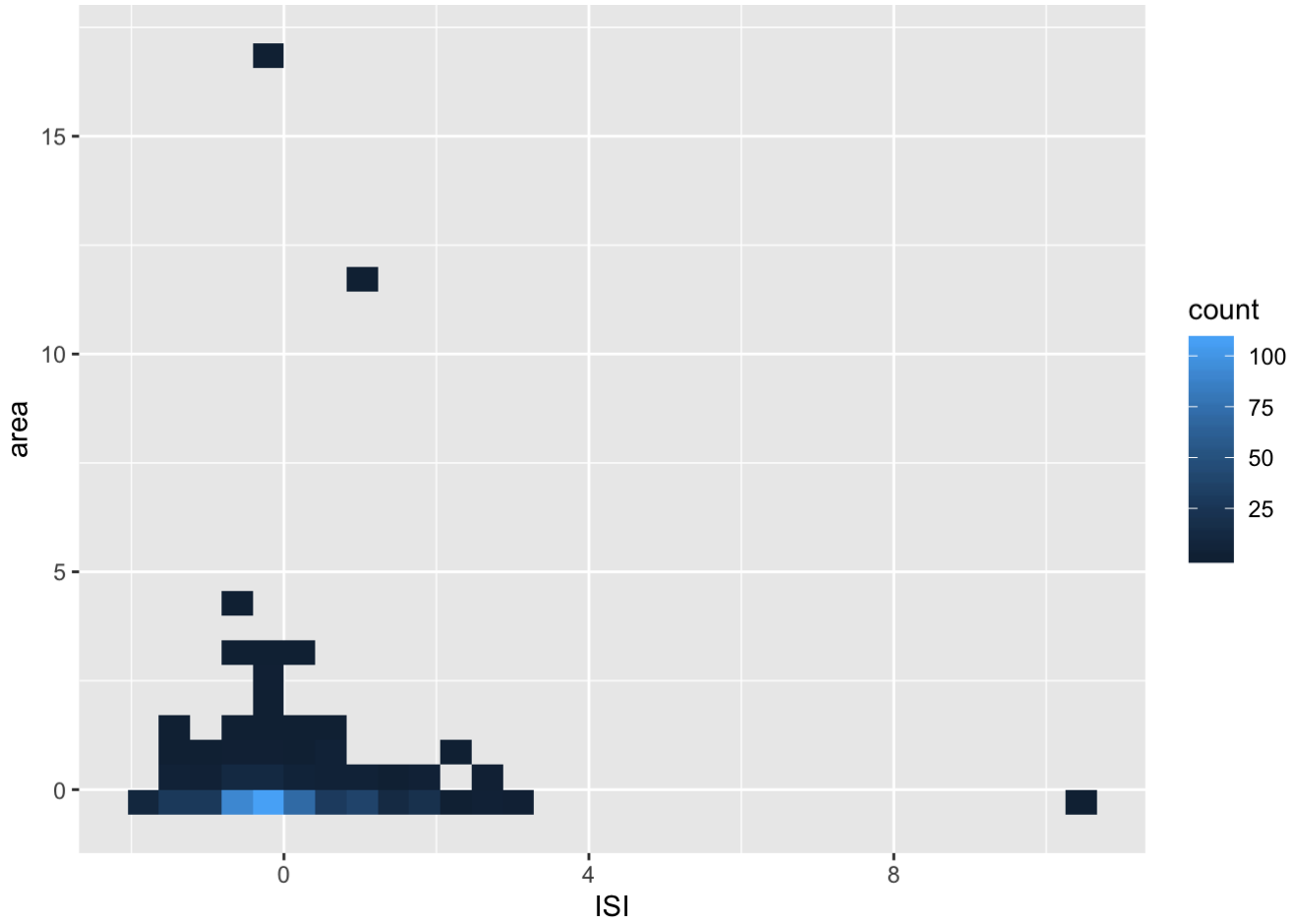
# melted data frame , using scaled values
## Any variables seem to vary by month? or correlated?
ggplot(data = mdata, aes(x = month, y = value, fill = variable)) +
  # `geom_col()` uses `stat_identity()`: it leaves the data as is.
  geom_col(position = 'dodge')
```



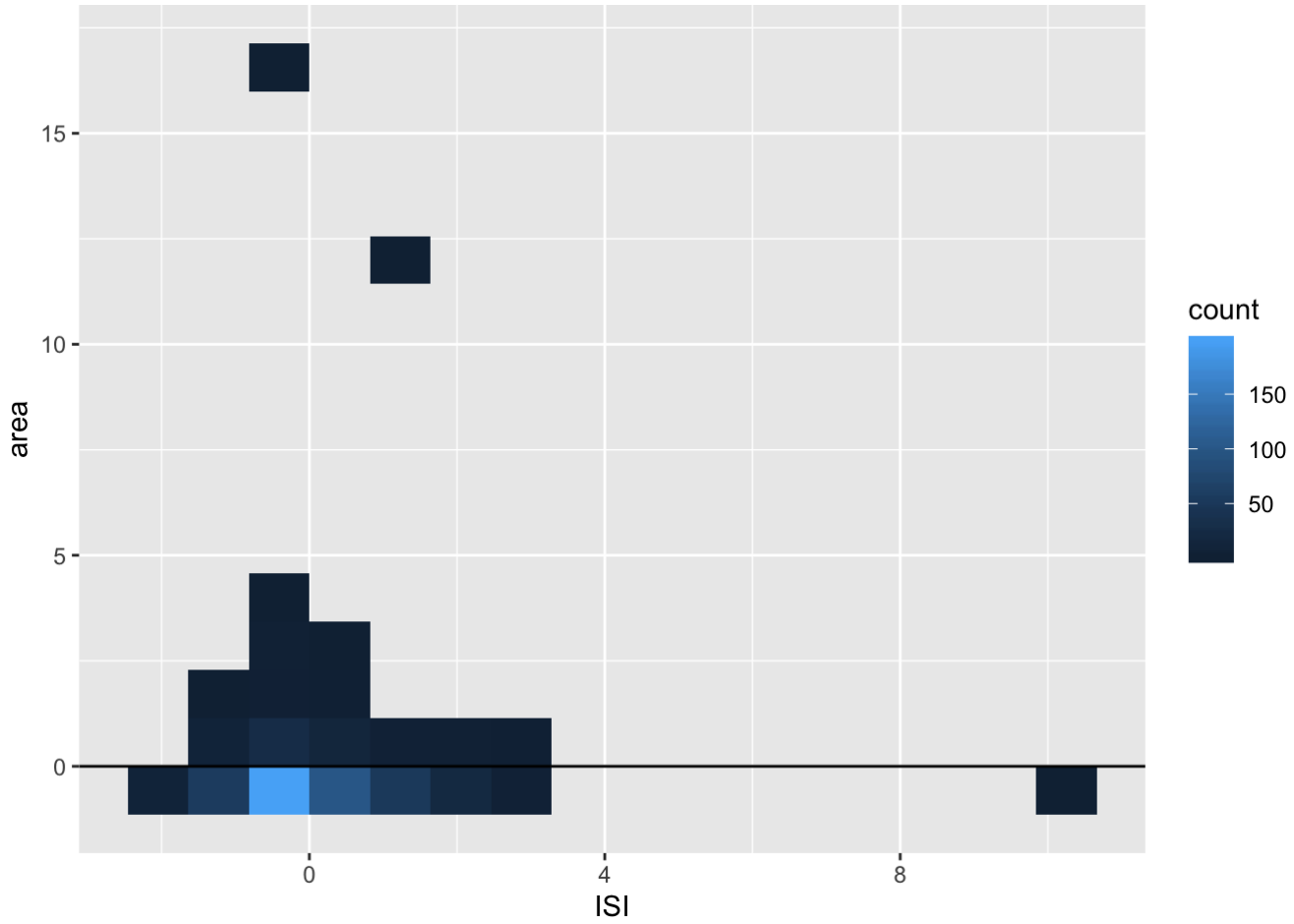

```
# Dot plot, freq of area burned by month
# Basic scatter plot
g1 = ggplot(data = forestfiresmm.scaled, aes_string(x = "month", y = "area")) +
  geom_point()
# Change the point size, and shape
g1 = g1 + geom_point(size = 1, shape = 23)
g1
```




```
# two variables continuous , plot for correlation
avg <- mean(forestfires.scaled$area)
c <- ggplot(forestfires.scaled, aes(ISI, area))
# Default plot
c + geom_bin2d()
```




```
# Change the number of bins
c + geom_bin2d(bins = 15)+geom_hline(aes(yintercept = avg))
```




```
###### DECISION TREE ######
# Set up
# Plot Observations
## We see the construction of the forest and points
plot(forestfires_na_factor$X,forestfires$Y)

## View fire data
summary(forestfires_na_factor$area)
```

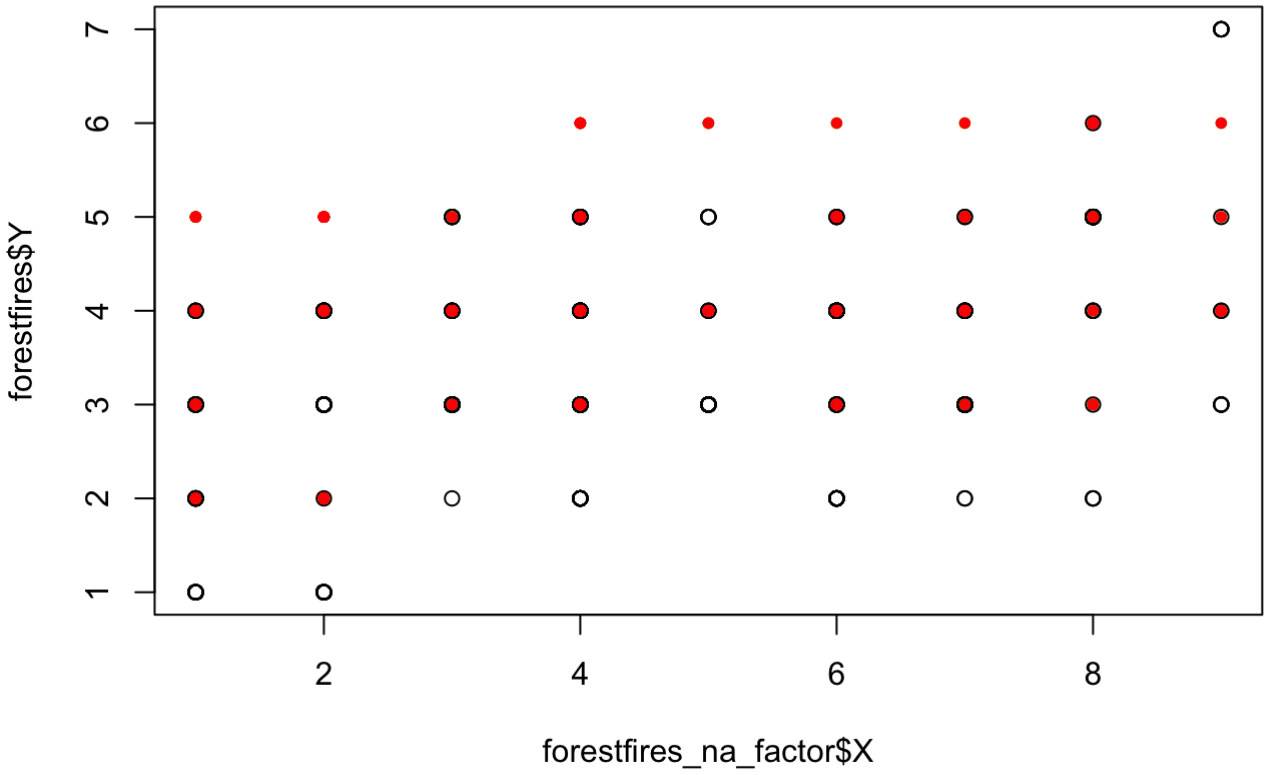
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    0.00    0.52   12.85    6.57 1090.84
```

```
# Note the mean and median
# View points where above average forest fire destruction
points(forestfires_na_factor$X[forestfires_na_factor$area>=.52], forestfires_na_factor$Y
[forestfires_na_factor$area>=.52], col="green", pch=20)

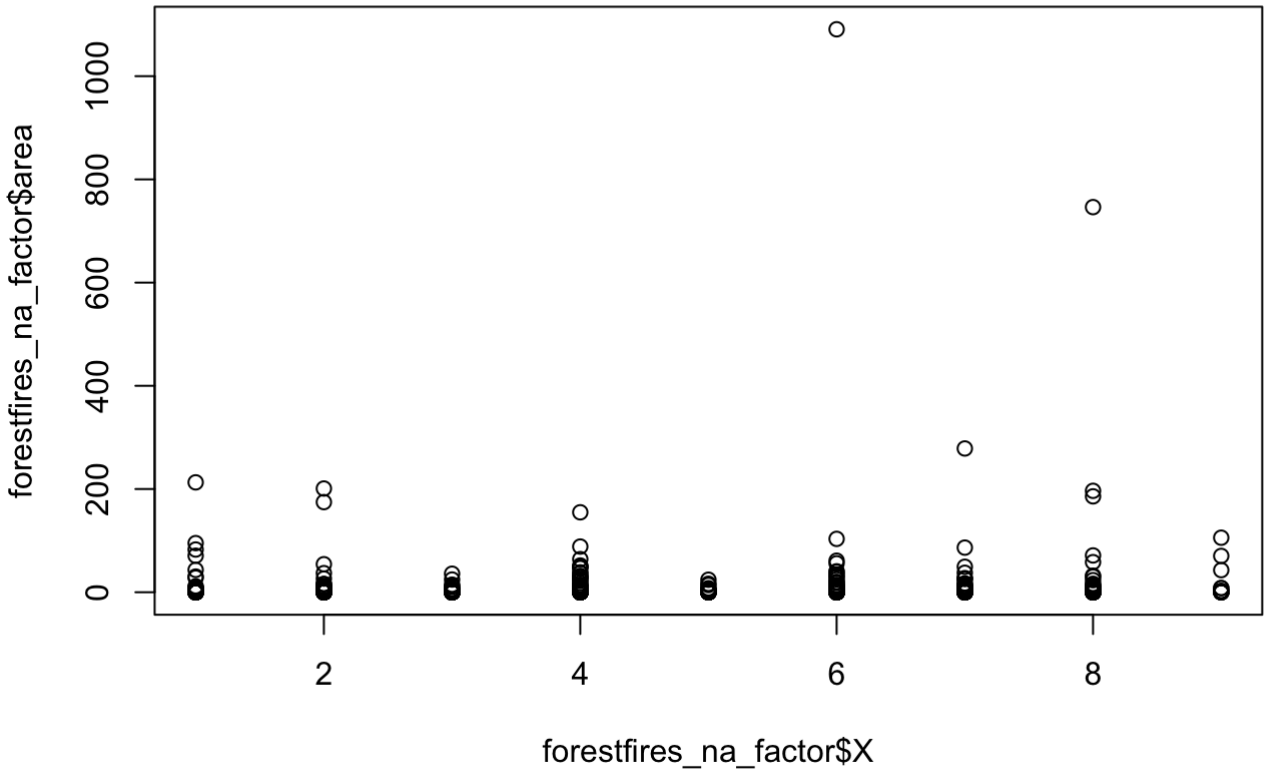
# Check the RH over areas
## View area
summary(forestfires_na_factor$area)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    0.00    0.00    0.52   12.85    6.57 1090.84
```

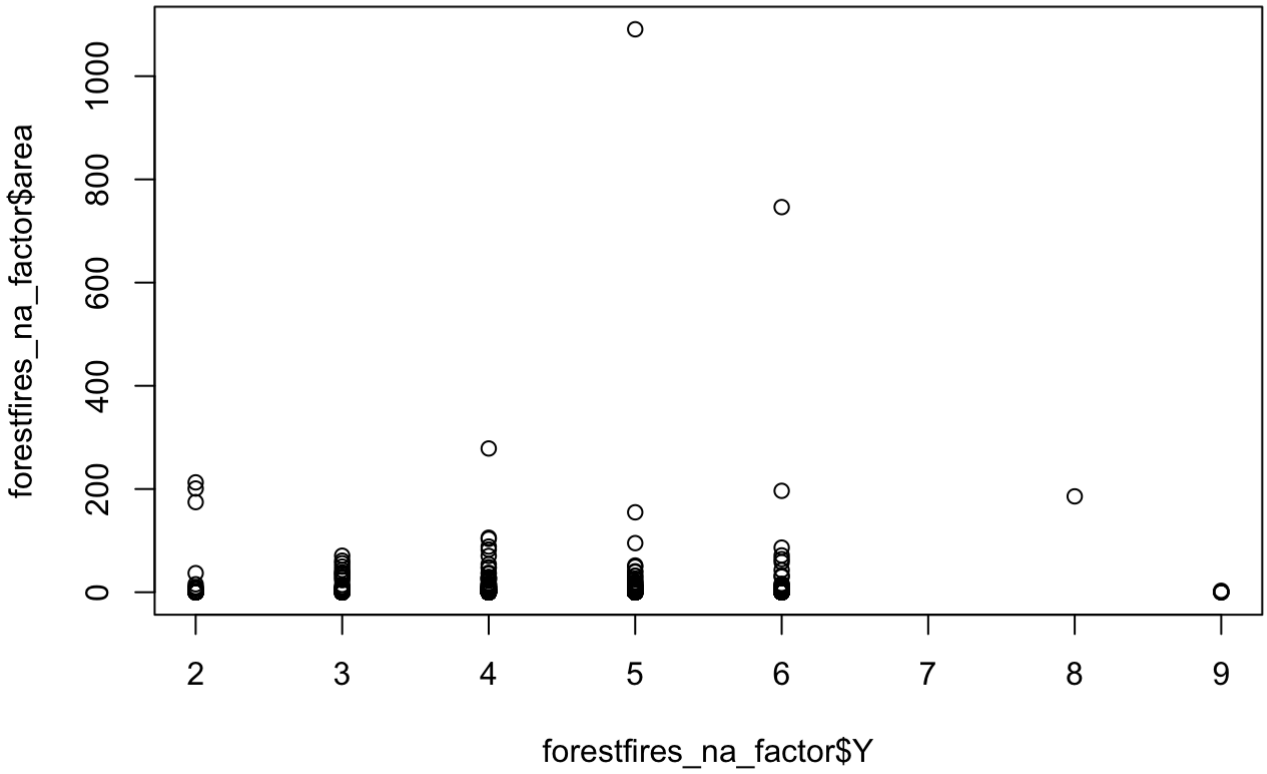
```
points(forestfires_na_factor$X[forestfires_na_factor$area>=.52], forestfires_na_factor$Y
[forestfires_na_factor$area>=.52], col="red", pch=20)
```




```
# View wether the data is linear
plot(forestfires_na_factor$X,forestfires_na_factor$area)
```




```
plot(forestfires_na_factor$Y,forestfires_na_factor$area)
```




```
# Linear Regression Model
latlonlm = lm(area ~ X + Y, data = forestfires_na_factor)
summary(latlonlm)
```

```
##
## Call:
## lm(formula = area ~ X + Y, data = forestfires_na_factor)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
##  -23.09  -13.86  -10.08   -5.37 1075.42
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.3976    10.1970   0.235    0.814
## X             1.5203     1.4383   1.057    0.291
## Y             0.7793     2.7058   0.288    0.773
##
## Residual standard error: 63.65 on 514 degrees of freedom
## Multiple R-squared:  0.004178,   Adjusted R-squared:  0.0003036
## F-statistic: 1.078 on 2 and 514 DF,  p-value: 0.3409
```

```
# R-Squared is around .3409 or 34%

# The linear model plots a blue money sign every time it thinks RH is above median valu
e.

# CART model
latlontree = rpart(area ~ X + Y, data=forestfires_na_factor)# Plot the tree using prp co
mmand defined in rpart.plot package
prp(latlontree)
```

```
fittedvalues = predict(latlontree)

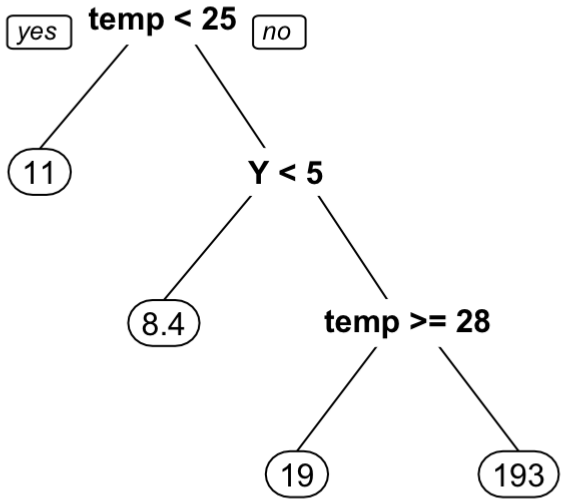
# Simplifying Tree by increasing minBucket
latlontree = rpart(area ~ X + Y, data=forestfires_na_factor, minbucket=50)
# plot(latlontree)
# text(latlontree)

# Prediction with Regression Trees
set.seed(123)
#split=sample.split(forestfires_na_factor$area, SplitRatio = 0.7)
split=sample.split(forestfires_na_factor$area, SplitRatio = 0.7)
train=subset(forestfires_na_factor, split==TRUE)
test=subset(forestfires_na_factor, split==FALSE)

# CV
CVdata <- dplyr::select(forestfires_na_factor,c(-1,-2))

Split_M <- as.matrix(CVdata)
Papers_M_N1 <- apply(Split_M, 1, function(i) round(i/sum(i),3))
Papers_Matrix_Norm <- t(Papers_M_N1)

# Create a CART model
tree = rpart(area ~ X + Y + FFMC + DMC + ISI + temp + RH + wind + rain, data=train)
prp(tree)
```



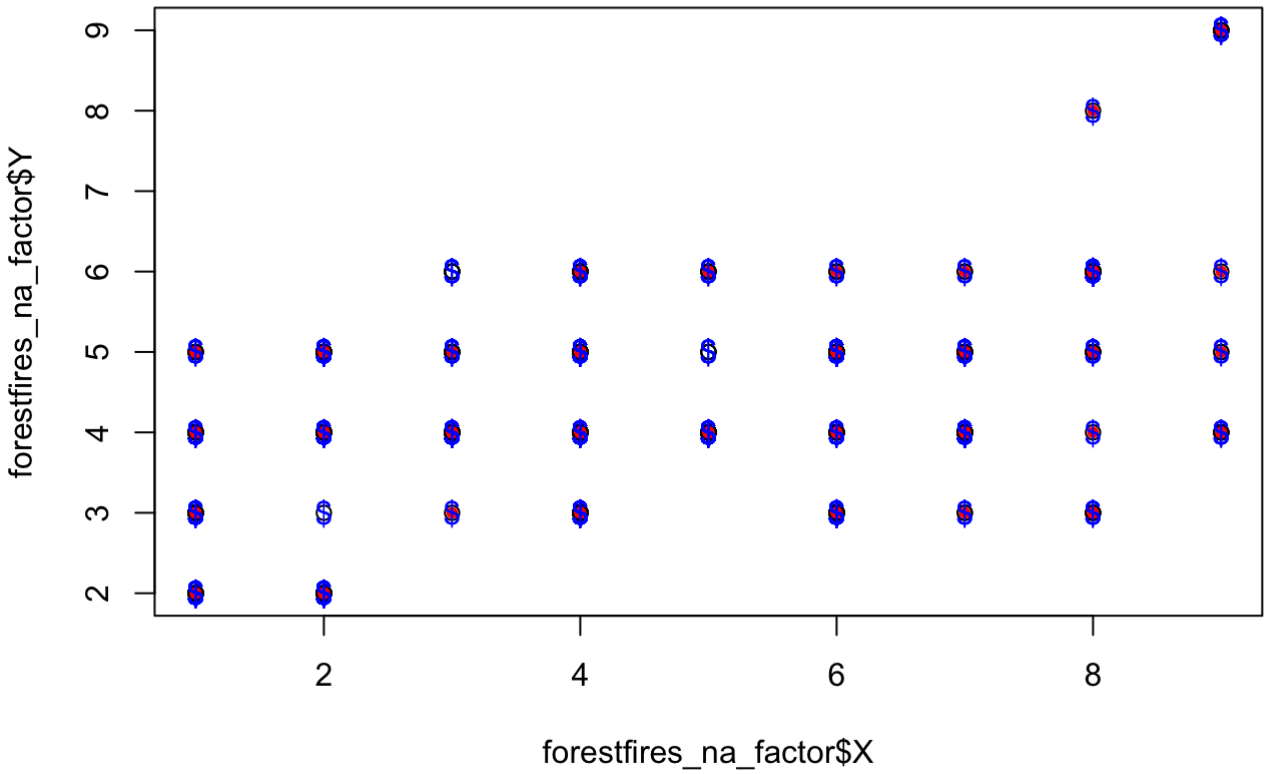
```
# Regression Tree Predictions
tree.pred = predict(tree, newdata=test)
tree.sse = sum((tree.pred - test$area)^2)
tree.sse
```

```
## [1] 83860.14
```

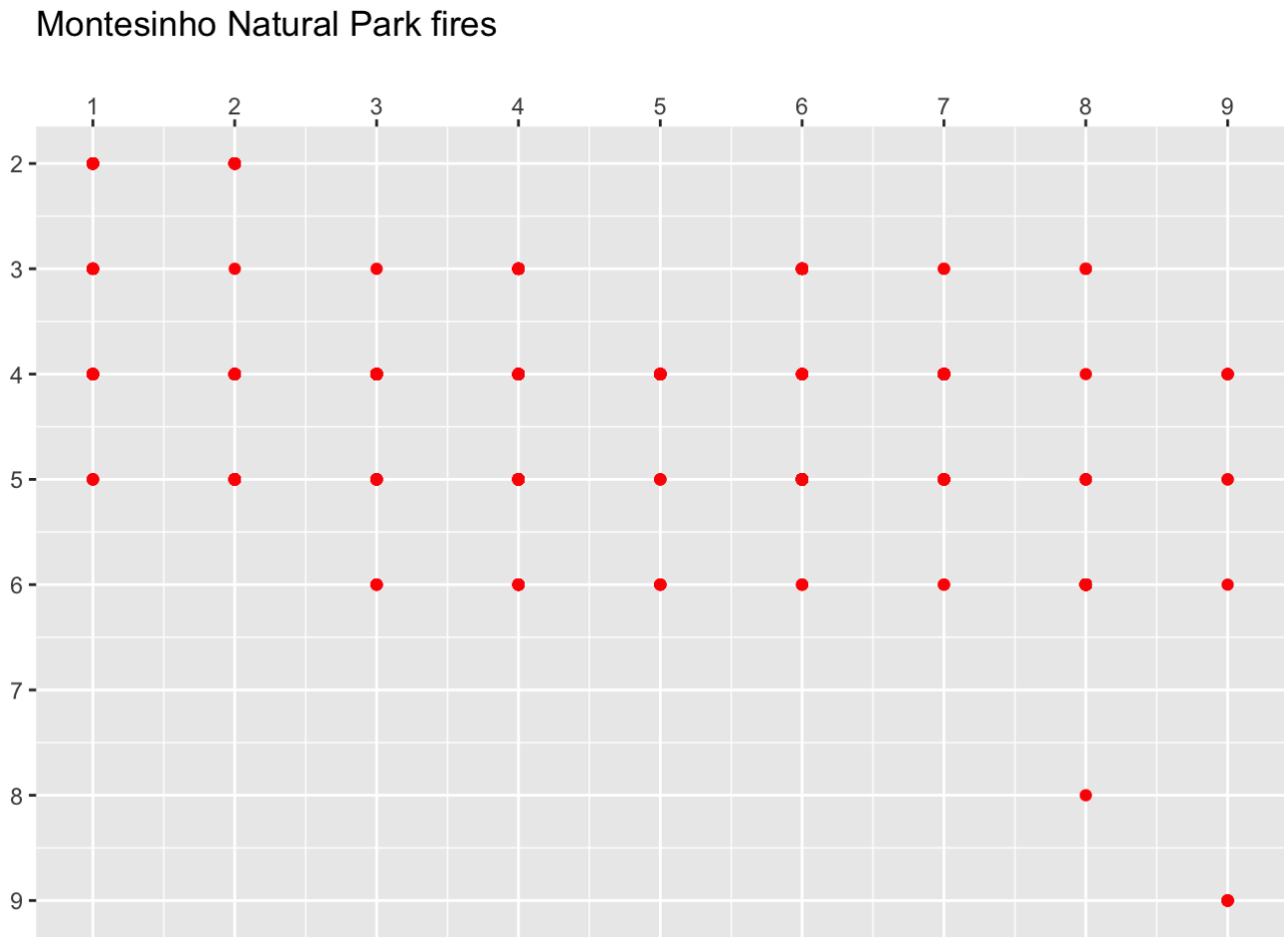
```
# Visualize regression output
plot(forestfires_na_factor$X, forestfires_na_factor$Y)
points(forestfires_na_factor$X[forestfires_na_factor$area>=.52], forestfires_na_factor$Y
[forestfires_na_factor$area>=.52], col="red", pch=20)> latlonlm$fitted.values
```

```
## logical(0)
```

```
points(forestfires_na_factor$X[latlonlm$fitted.values >= .52], forestfires_na_factor$Y[l
atlonlm$fitted.values >= .52], col="blue", pch="$")
```

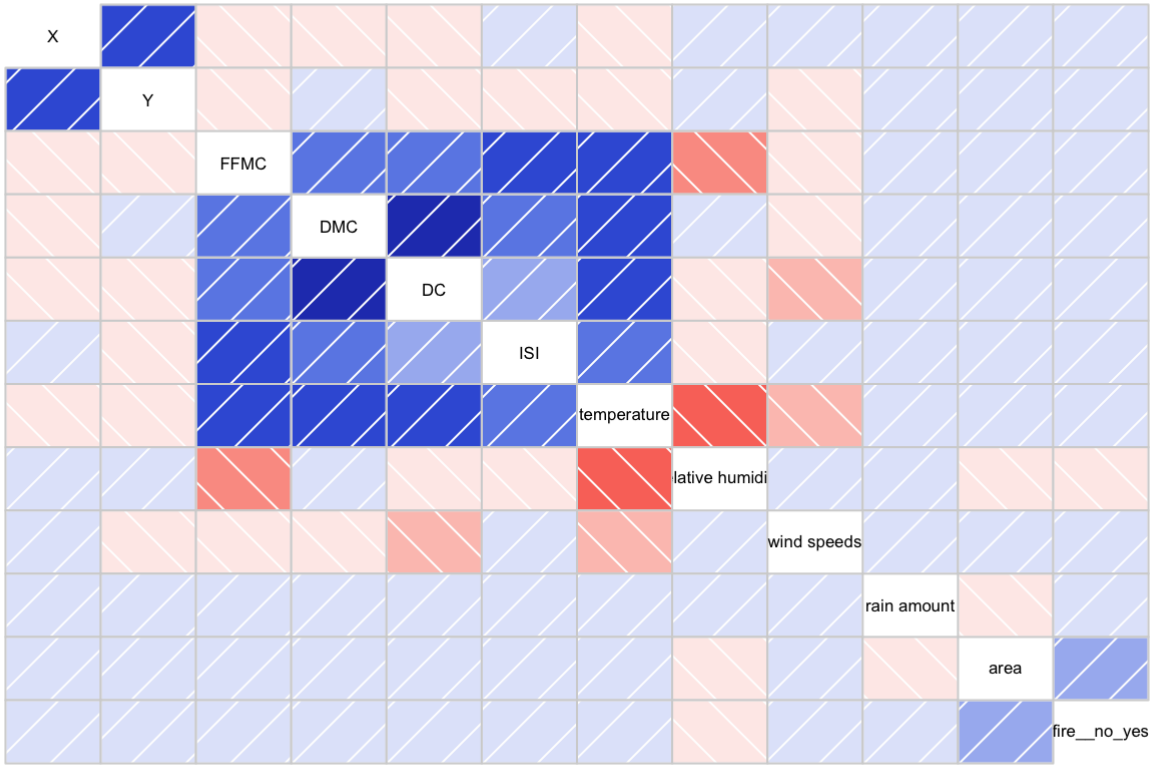


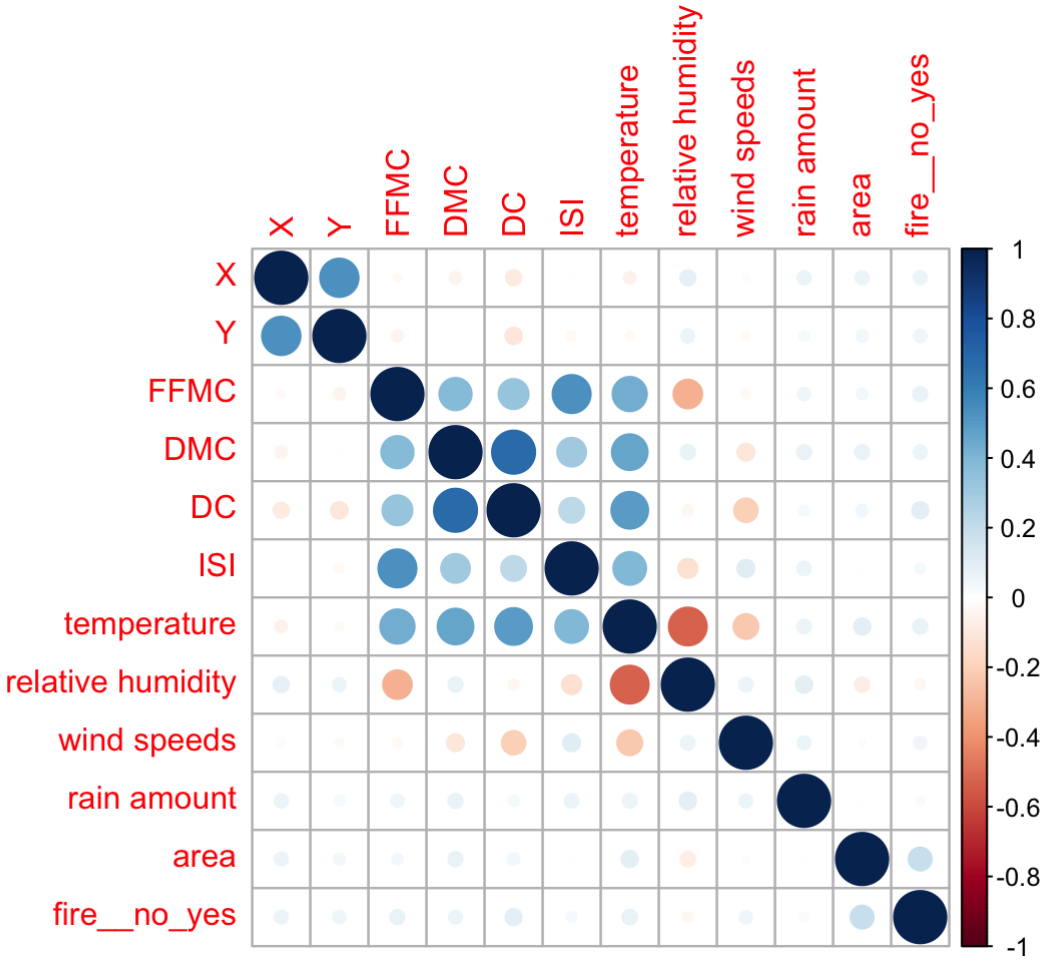
```
# Create basic x and y cord  plot in ggplot
pointgg = ggplot(forestfires_na_factor,aes(x = forestfires_na_factor$X, y = forestfires_
na_factor$Y))
pointgg = pointgg + geom_point(color="red")
pointgg = pointgg + scale_y_reverse(breaks = pretty(forestfires_na_factor$Y,n=9)) + scal
e_x_continuous(position = 'top',breaks = pretty(forestfires_na_factor$X, n = 9))
pointgg = pointgg + labs(title = "Montesinho Natural Park fires",x="",y="")
pointgg
```




```
# SVM and Random Forest
ForestFiresWith <- read_excel("ForestFiresWith.xlsx")

ff <- ForestFiresWith
View(ff)
#corrplot(ff, method = "number")
corrplot(corrgram(ff))
```


X
Y
FFMC
DMC
DC
ISI
temperature
lative humidi
wind speeds
rain amount
area
fire__no_yes


X
Y
FFMC
DMC
DC
ISI
temperature
relative humidity
wind speeds
rain amount
area
fire__no_yes
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1

```
summary(ff)
```

```
##        X               Y          month               day
##  Min.   :1.000   Min.   :2.0   Length:517         Length:517
##  1st Qu.:3.000   1st Qu.:4.0   Class :character   Class :character
##  Median :4.000   Median :4.0   Mode  :character   Mode  :character
##  Mean   :4.669   Mean   :4.3
##  3rd Qu.:7.000   3rd Qu.:5.0
##  Max.   :9.000   Max.   :9.0
##       FFMC             DMC              DC             ISI
##  Min.   :18.70   Min.   :  1.1   Min.   :  7.9   Min.   : 0.000
##  1st Qu.:90.20   1st Qu.: 68.6   1st Qu.:437.7   1st Qu.: 6.500
##  Median :91.60   Median :108.3   Median :664.2   Median : 8.400
##  Mean   :90.64   Mean   :110.9   Mean   :547.9   Mean   : 9.022
##  3rd Qu.:92.90   3rd Qu.:142.4   3rd Qu.:713.9   3rd Qu.:10.800
##  Max.   :96.20   Max.   :291.3   Max.   :860.6   Max.   :56.100
##   temperature    relative humidity  wind speeds     rain amount
##  Min.   : 2.20   Min.   : 15.00    Min.   :0.400   Min.   :0.00000
##  1st Qu.:15.50   1st Qu.: 33.00    1st Qu.:2.700   1st Qu.:0.00000
##  Median :19.30   Median : 42.00    Median :4.000   Median :0.00000
##  Mean   :18.89   Mean   : 44.29    Mean   :4.018   Mean   :0.02166
##  3rd Qu.:22.80   3rd Qu.: 53.00    3rd Qu.:4.900   3rd Qu.:0.00000
##  Max.   :33.30   Max.   :100.00    Max.   :9.400   Max.   :6.40000
##       area          fire__no_yes
##  Min.   :   0.00   Min.   :0.0000
##  1st Qu.:   0.00   1st Qu.:0.0000
##  Median :   0.52   Median :1.0000
##  Mean   :  12.85   Mean   :0.5222
##  3rd Qu.:   6.57   3rd Qu.:1.0000
##  Max.   :1090.84   Max.   :1.0000
```

```
ff <- ff[,-13]
str(ff)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    517 obs. of  13 variables:
##  $ X                : num  7 2 2 3 5 6 6 3 2 6 ...
##  $ Y                : num  5 4 2 4 4 5 4 4 4 3 ...
##  $ month            : chr  "apr" "jan" "feb" "mar" ...
##  $ day              : chr  "sun" "sat" "sat" "sat" ...
##  $ FFMC             : num  81.9 82.1 79.5 69 85.2 75.1 75.1 86.9 93.4 91 ...
##  $ DMC              : num  3 3.7 3.6 2.4 4.9 4.4 4.4 6.6 15 14.6 ...
##  $ DC               : num  7.9 9.3 15.3 15.5 15.8 16.2 16.2 18.7 25.6 25.6 ...
##  $ ISI              : num  3.5 2.9 1.8 0.7 6.3 1.9 1.9 3.2 11.4 12.3 ...
##  $ temperature      : num  13.4 5.3 4.6 17.4 7.5 4.6 5.1 8.8 15.2 13.7 ...
##  $ relative humidity: num  75 78 59 24 46 82 77 35 19 33 ...
##  $ wind speeds      : num  1.8 3.1 0.9 5.4 8 6.3 5.4 3.1 7.6 9.4 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ fire__no_yes     : num  0 0 1 0 1 1 1 1 0 1 ...
```

```
sapply(ff, sd)
```

```
## Warning in var(if (is.vector(x) || is.factor(x)) x else as.double(x), na.rm
## = na.rm): NAs introduced by coercion
```

```
## Warning in var(if (is.vector(x) || is.factor(x)) x else as.double(x), na.rm
## = na.rm): NAs introduced by coercion
```

```
##                X                Y            month              day
##         2.3137778         1.2299004               NA               NA
##              FFMC              DMC               DC              ISI
##         5.5201108        64.0464822       248.0661917         4.5594772
##       temperature relative humidity       wind speeds       rain amount
##         5.8066253        16.3174692         1.7916526         0.2959591
##      fire__no_yes
##         0.4999888
```

```
trainRatio <- .67
set.seed(1016) # Set Seed so that same sample can be reproduced in future also
sample <- sample.int(n = nrow(ff), size = floor(trainRatio*nrow(ff)), replace = FALSE)
ff$X <- log(ff$X)
testdata <- ff[-sample, ]
testdata
```

```
## # A tibble: 171 x 13
##        X     Y month day    FFMC   DMC    DC   ISI temperature
##    <dbl> <dbl> <chr> <chr> <dbl> <dbl> <dbl> <dbl>       <dbl>
##  1 1.95      5 apr   sun    81.9   3     7.9   3.5        13.4
##  2 1.79      5 feb   tue    75.1   4.4  16.2   1.9         4.6
##  3 1.10      4 feb   wed    86.9   6.6  18.7   3.2         8.8
##  4 1.79      3 apr   sun    91    14.6  25.6  12.3        13.7
##  5 1.10      4 feb   sat    83.9   8    30.2   2.6        12.7
##  6 1.61      5 mar   thu    90.9  18.9  30.6   8          11.6
##  7 1.79      5 mar   mon    87.2  15.1  36.9   7.1        10.2
##  8 0.693     2 feb   fri    86.6  13.2  43     5.3        12.3
##  9 1.79      5 mar   thu    91.3  20.6  43.5   8.5        13.3
## 10 1.39      5 feb   sun    85     9    56.9   3.5        10.1
## # … with 161 more rows, and 4 more variables: `relative humidity` <dbl>,
## #   `wind speeds` <dbl>, `rain amount` <dbl>, fire__no_yes <dbl>
```

```
testdata <- testdata[, -c(3:4)]
summary(testdata)
```

```
##        X                Y              FFMC            DMC        
##  Min.   :0.0000   Min.   :2.00   Min.   :50.40   Min.   :  3.00  
##  1st Qu.:0.6931   1st Qu.:4.00   1st Qu.:90.10   1st Qu.: 51.75  
##  Median :1.3863   Median :4.00   Median :91.60   Median : 97.90  
##  Mean   :1.3224   Mean   :4.17   Mean   :90.48   Mean   :100.55  
##  3rd Qu.:1.9459   3rd Qu.:5.00   3rd Qu.:92.50   3rd Qu.:130.90  
##  Max.   :2.1972   Max.   :9.00   Max.   :96.10   Max.   :276.30  
##        DC             ISI          temperature    relative humidity
##  Min.   :  7.9   Min.   : 0.400   Min.   : 4.60   Min.   :17.00    
##  1st Qu.:399.9   1st Qu.: 6.700   1st Qu.:14.65   1st Qu.:32.50    
##  Median :664.5   Median : 8.400   Median :18.70   Median :41.00    
##  Mean   :536.5   Mean   : 8.763   Mean   :18.18   Mean   :44.82    
##  3rd Qu.:713.5   3rd Qu.:10.100   3rd Qu.:21.85   3rd Qu.:54.00    
##  Max.   :825.1   Max.   :22.600   Max.   :30.60   Max.   :99.00    
##   wind speeds     rain amount       fire__no_yes
##  Min.   :0.900   Min.   :0.00000   Min.   :0.0000  
##  1st Qu.:2.700   1st Qu.:0.00000   1st Qu.:0.0000  
##  Median :4.000   Median :0.00000   Median :1.0000  
##  Mean   :4.029   Mean   :0.01287   Mean   :0.5322  
##  3rd Qu.:5.400   3rd Qu.:0.00000   3rd Qu.:1.0000  
##  Max.   :9.400   Max.   :1.40000   Max.   :1.0000
```

```
traindata <- ff[sample, ]
traindata <- traindata[, -c(3:4)]
summary(traindata)
```

```
##        X                Y              FFMC            DMC        
##  Min.   :0.000   Min.   :2.000   Min.   :18.70   Min.   :  1.10  
##  1st Qu.:1.099   1st Qu.:4.000   1st Qu.:90.30   1st Qu.: 80.75  
##  Median :1.386   Median :4.000   Median :91.70   Median :111.70  
##  Mean   :1.403   Mean   :4.364   Mean   :90.73   Mean   :115.97  
##  3rd Qu.:1.946   3rd Qu.:5.000   3rd Qu.:93.10   3rd Qu.:146.97  
##  Max.   :2.197   Max.   :9.000   Max.   :96.20   Max.   :291.30  
##        DC             ISI          temperature    relative humidity
##  Min.   :  9.3   Min.   : 0.00   Min.   : 2.20   Min.   : 15.00   
##  1st Qu.:474.9   1st Qu.: 6.30   1st Qu.:16.10   1st Qu.: 33.00   
##  Median :661.8   Median : 8.40   Median :19.60   Median : 42.00   
##  Mean   :553.6   Mean   : 9.15   Mean   :19.24   Mean   : 44.03   
##  3rd Qu.:713.9   3rd Qu.:11.30   3rd Qu.:23.30   3rd Qu.: 53.00   
##  Max.   :860.6   Max.   :56.10   Max.   :33.30   Max.   :100.00   
##   wind speeds     rain amount       fire__no_yes
##  Min.   :0.400   Min.   :0.00000   Min.   :0.0000  
##  1st Qu.:2.700   1st Qu.:0.00000   1st Qu.:0.0000  
##  Median :4.000   Median :0.00000   Median :1.0000  
##  Mean   :4.012   Mean   :0.02601   Mean   :0.5173  
##  3rd Qu.:4.900   3rd Qu.:0.00000   3rd Qu.:1.0000  
##  Max.   :9.400   Max.   :6.40000   Max.   :1.0000
```

```
probit2 <- glm(traindata$fire__no_yes ~.,  family = binomial(link = "probit"), data=trai
ndata[,-(length(traindata))])
logit2 <- glm(traindata$fire__no_yes ~.,  family = "binomial", data=traindata[,-(length
(traindata))])
summary(probit2)
```

```
##
## Call:
## glm(formula = traindata$fire__no_yes ~ ., family = binomial(link = "probit"),
##     data = traindata[, -(length(traindata))])
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5800  -1.2101   0.9448   1.0934   1.7574
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -2.404e+00  1.951e+00  -1.232    0.218
## X                   -2.242e-02  1.330e-01  -0.169    0.866
## Y                    7.824e-02  6.516e-02   1.201    0.230
## FFMC                 2.134e-02  2.131e-02   1.002    0.317
## DMC                 -4.241e-05  1.594e-03  -0.027    0.979
## DC                   5.414e-04  4.190e-04   1.292    0.196
## ISI                 -7.071e-03  1.828e-02  -0.387    0.699
## temperature         -2.772e-04  1.850e-02  -0.015    0.988
## `relative humidity` -4.395e-03  5.911e-03  -0.743    0.457
## `wind speeds`        4.126e-02  4.156e-02   0.993    0.321
## `rain amount`        1.005e-01  2.206e-01   0.456    0.649
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 479.24  on 345  degrees of freedom
## Residual deviance: 468.43  on 335  degrees of freedom
## AIC: 490.43
##
## Number of Fisher Scoring iterations: 5
```

```
summary(logit2)
```

```
##
## Call:
## glm(formula = traindata$fire__no_yes ~ ., family = "binomial",
##     data = traindata[, -(length(traindata))])
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.5808  -1.2077   0.9434   1.0929   1.7544
##
## Coefficients:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept)         -3.887e+00  3.318e+00  -1.172    0.241
## X                   -3.643e-02  2.133e-01  -0.171    0.864
## Y                    1.278e-01  1.049e-01   1.218    0.223
## FFMC                 3.429e-02  3.643e-02   0.941    0.347
## DMC                 -9.527e-05  2.557e-03  -0.037    0.970
## DC                   8.820e-04  6.740e-04   1.309    0.191
## ISI                 -1.095e-02  2.985e-02  -0.367    0.714
## temperature         -2.139e-04  2.972e-02  -0.007    0.994
## `relative humidity` -7.108e-03  9.503e-03  -0.748    0.455
## `wind speeds`        6.738e-02  6.689e-02   1.007    0.314
## `rain amount`        1.503e-01  3.715e-01   0.405    0.686
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 479.24  on 345  degrees of freedom
## Residual deviance: 468.44  on 335  degrees of freedom
## AIC: 490.44
##
## Number of Fisher Scoring iterations: 4
```

```
predictedlogit <- plogis(predict(logit2, testdata))
predictedprobit <- plogis(predict(probit2, testdata))
table(predictedlogit > 0.5, testdata$fire__no_yes)
```

```
##
##          0  1
##   FALSE 35 29
##   TRUE  45 62
```

```
### SVM Model
traindata2 <- traindata
svmclassifier = svm(formula = traindata2$`fire__no_yes` ~ .,
                    data = traindata2,
                    type = 'C-classification',
                    kernel = 'linear')

testdata2 <- testdata
#y_pred <- predict(svmclassifier, newdata = testdata2[-9])
y_pred <- predict(svmclassifier, newdata = testdata2)
cm <- table(testdata2$`fire__no_yes`, y_pred)
cm
```

```
##    y_pred
##      0  1
##   0 22 58
##   1 19 72
```

```
prediction <- predict(svmclassifier, newdata = testdata2)
results <- data.frame(testdata2$`fire__no_yes`, prediction)
colnames(results) <- c("Actual", "Prediction")
str(results)
```

```
## 'data.frame':    171 obs. of  2 variables:
##  $ Actual    : num  0 1 1 1 0 0 1 0 1 1 ...
##  $ Prediction: Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 1 1 ...
```

```
results$Prediction <- as.factor(results$Prediction)
results$Actual <- as.factor(results$Actual)
confusionMatrix(results$Prediction, results$Actual)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 22 19
##          1 58 72
##
##                Accuracy : 0.5497
##                  95% CI : (0.4719, 0.6258)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.3514
##
##                   Kappa : 0.0682
##
##  Mcnemar's Test P-Value : 1.488e-05
##
##             Sensitivity : 0.2750
##             Specificity : 0.7912
##          Pos Pred Value : 0.5366
##          Neg Pred Value : 0.5538
##              Prevalence : 0.4678
##          Detection Rate : 0.1287
##    Detection Prevalence : 0.2398
##       Balanced Accuracy : 0.5331
##
##        'Positive' Class : 0
##
```

```
svmclassifier2 = svm(formula = traindata2$`fire__no_yes` ~ .,
                     data = traindata2,
                     type = 'C-classification',
                     kernel = 'polynomial')

y_pred <- predict(svmclassifier2, newdata = testdata2)
cm <- table(testdata2$`fire__no_yes`, y_pred)
cm
```

```
##    y_pred
##      0  1
##   0 25 55
##   1 16 75
```

```
prediction <- predict(svmclassifier2, newdata = testdata2)
results <- data.frame(testdata2$`fire__no_yes`, prediction)
colnames(results) <- c("Actual", "Prediction")
str(results)
```

```
## 'data.frame':    171 obs. of  2 variables:
##  $ Actual    : num  0 1 1 1 0 0 1 0 1 1 ...
##  $ Prediction: Factor w/ 2 levels "0","1": 1 2 1 2 1 1 2 2 1 1 ...
```

```
results$Prediction <- as.factor(results$Prediction)
results$Actual <- as.factor(results$Actual)
confusionMatrix(results$Prediction, results$Actual)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 25 16
##          1 55 75
##
##                Accuracy : 0.5848
##                  95% CI : (0.5071, 0.6595)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.09606
##
##                   Kappa : 0.1408
##
##  Mcnemar's Test P-Value : 6.49e-06
##
##             Sensitivity : 0.3125
##             Specificity : 0.8242
##          Pos Pred Value : 0.6098
##          Neg Pred Value : 0.5769
##              Prevalence : 0.4678
##          Detection Rate : 0.1462
##    Detection Prevalence : 0.2398
##       Balanced Accuracy : 0.5683
##
##        'Positive' Class : 0
##
```

```
svmclassifier3 = svm(formula = traindata2$`fire__no_yes` ~ .,
                     data = traindata2,
                     type = 'C-classification',
                     kernel = 'sigmoid')

y_pred <- predict(svmclassifier3, newdata = testdata2)
cm <- table(testdata2$`fire__no_yes`, y_pred)
cm
```

```
##    y_pred
##      0  1
##   0 27 53
##   1 33 58
```

```
prediction <- predict(svmclassifier3, newdata = testdata2)
results <- data.frame(testdata2$`fire__no_yes`, prediction)
colnames(results) <- c("Actual", "Prediction")
str(results)
```

```
## 'data.frame':    171 obs. of  2 variables:
##  $ Actual    : num  0 1 1 1 0 0 1 0 1 1 ...
##  $ Prediction: Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 2 1 ...
```

```
results$Prediction <- as.factor(results$Prediction)
results$Actual <- as.factor(results$Actual)
confusionMatrix(results$Prediction, results$Actual)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 27 33
##          1 53 58
##
##                Accuracy : 0.4971
##                  95% CI : (0.4198, 0.5744)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.84043
##
##                   Kappa : -0.0255
##
##  Mcnemar's Test P-Value : 0.04048
##
##             Sensitivity : 0.3375
##             Specificity : 0.6374
##          Pos Pred Value : 0.4500
##          Neg Pred Value : 0.5225
##              Prevalence : 0.4678
##          Detection Rate : 0.1579
##    Detection Prevalence : 0.3509
##       Balanced Accuracy : 0.4874
##
##        'Positive' Class : 0
##
```

```
svmclassifier4 = svm(formula = traindata2$`fire__no_yes` ~ .,
                     data = traindata2,
                     type = 'C-classification',
                     kernel = 'radial')

y_pred <- predict(svmclassifier4, newdata = testdata2)
cm <- table(testdata2$`fire__no_yes`, y_pred)
cm
```

```
##    y_pred
##      0  1
##   0 44 36
##   1 41 50
```

```
prediction <- predict(svmclassifier4, newdata = testdata2)
results <- data.frame(testdata2$`fire__no_yes`, prediction)
colnames(results) <- c("Actual", "Prediction")
str(results)
```

```
## 'data.frame':    171 obs. of  2 variables:
##  $ Actual    : num  0 1 1 1 0 0 1 0 1 1 ...
##  $ Prediction: Factor w/ 2 levels "0","1": 1 2 1 2 1 1 1 1 1 1 ...
```

```
results$Prediction <- as.factor(results$Prediction)
results$Actual <- as.factor(results$Actual)
confusionMatrix(results$Prediction, results$Actual)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 44 41
##          1 36 50
##
##                Accuracy : 0.5497
##                  95% CI : (0.4719, 0.6258)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.3514
##
##                   Kappa : 0.0991
##
##  Mcnemar's Test P-Value : 0.6485
##
##             Sensitivity : 0.5500
##             Specificity : 0.5495
##          Pos Pred Value : 0.5176
##          Neg Pred Value : 0.5814
##              Prevalence : 0.4678
##          Detection Rate : 0.2573
##    Detection Prevalence : 0.4971
##       Balanced Accuracy : 0.5497
##
##        'Positive' Class : 0
##
```

```
###created XY coordinates and adding it to ff
df <- paste(ff$X,",",ff$Y)
df <- as.data.frame(df)
colnames(df) <- "coordinates"
df
```

```
##               coordinates
## 1    1.94591014905531 , 5
## 2   0.693147180559945 , 4
## 3   0.693147180559945 , 2
## 4    1.09861228866811 , 4
## 5     1.6094379124341 , 4
## 6    1.79175946922805 , 5
## 7    1.79175946922805 , 4
## 8    1.09861228866811 , 4
## 9   0.693147180559945 , 4
## 10   1.79175946922805 , 3
## 11    1.6094379124341 , 4
## 12   2.19722457733622 , 9
## 13   1.79175946922805 , 5
## 14   1.09861228866811 , 4
## 15   1.09861228866811 , 4
## 16   1.79175946922805 , 5
## 17    1.6094379124341 , 5
## 18   1.94591014905531 , 4
## 19  0.693147180559945 , 2
## 20   1.79175946922805 , 5
## 21   1.09861228866811 , 4
## 22   1.79175946922805 , 5
## 23  0.693147180559945 , 2
## 24   2.19722457733622 , 9
## 25   1.79175946922805 , 3
## 26   1.79175946922805 , 5
## 27   1.94591014905531 , 4
## 28   1.79175946922805 , 5
## 29    1.6094379124341 , 4
## 30   1.79175946922805 , 3
## 31   1.79175946922805 , 5
## 32   1.38629436111989 , 5
## 33   1.79175946922805 , 5
## 34   1.79175946922805 , 5
## 35   1.38629436111989 , 5
## 36   1.38629436111989 , 5
## 37   1.38629436111989 , 4
## 38   1.94591014905531 , 4
## 39   1.38629436111989 , 4
## 40   1.38629436111989 , 6
## 41   1.38629436111989 , 4
## 42   1.09861228866811 , 4
## 43   1.09861228866811 , 5
## 44   1.09861228866811 , 5
## 45   1.79175946922805 , 4
## 46   1.38629436111989 , 3
## 47   1.38629436111989 , 5
## 48   1.38629436111989 , 5
## 49    1.6094379124341 , 4
## 50   1.09861228866811 , 4
## 51   2.07944154167984 , 6
## 52    1.6094379124341 , 5
```

```
## 53   1.79175946922805 , 5
## 54   2.07944154167984 , 6
## 55   1.09861228866811 , 4
## 56   1.09861228866811 , 4
## 57   1.38629436111989 , 4
## 58   1.38629436111989 , 4
## 59   1.79175946922805 , 5
## 60   1.38629436111989 , 4
## 61   1.09861228866811 , 4
## 62    1.6094379124341 , 4
## 63   1.94591014905531 , 4
## 64   1.79175946922805 , 5
## 65   1.38629436111989 , 6
## 66   1.79175946922805 , 4
## 67   1.94591014905531 , 4
## 68   1.94591014905531 , 5
## 69   1.79175946922805 , 4
## 70   1.38629436111989 , 5
## 71   1.79175946922805 , 5
## 72   1.79175946922805 , 5
## 73   1.79175946922805 , 3
## 74    1.6094379124341 , 6
## 75    1.6094379124341 , 5
## 76   2.07944154167984 , 6
## 77  0.693147180559945 , 2
## 78  0.693147180559945 , 2
## 79   1.38629436111989 , 6
## 80   2.07944154167984 , 6
## 81   1.38629436111989 , 4
## 82                  0 , 3
## 83   1.09861228866811 , 5
## 84   1.94591014905531 , 3
## 85   1.38629436111989 , 3
## 86   1.79175946922805 , 3
## 87   1.79175946922805 , 5
## 88   1.38629436111989 , 5
## 89   1.94591014905531 , 4
## 90   2.07944154167984 , 3
## 91   1.09861228866811 , 6
## 92   1.09861228866811 , 6
## 93   1.79175946922805 , 5
## 94   2.19722457733622 , 4
## 95   1.79175946922805 , 4
## 96   2.07944154167984 , 6
## 97                  0 , 2
## 98   2.19722457733622 , 5
## 99   2.19722457733622 , 5
## 100  1.79175946922805 , 5
## 101  1.79175946922805 , 5
## 102 0.693147180559945 , 2
## 103  2.19722457733622 , 9
## 104  1.38629436111989 , 3
## 105  1.38629436111989 , 4
## 106  1.09861228866811 , 4
```

```
## 107  1.38629436111989 , 4
## 108  1.38629436111989 , 4
## 109  1.79175946922805 , 5
## 110 0.693147180559945 , 5
## 111  1.38629436111989 , 6
## 112  1.38629436111989 , 6
## 113  1.38629436111989 , 6
## 114  1.79175946922805 , 3
## 115  2.07944154167984 , 6
## 116  2.19722457733622 , 9
## 117  1.38629436111989 , 4
## 118                 0 , 2
## 119 0.693147180559945 , 5
## 120  2.07944154167984 , 6
## 121  1.38629436111989 , 3
## 122 0.693147180559945 , 5
## 123  1.38629436111989 , 3
## 124  1.94591014905531 , 4
## 125  1.09861228866811 , 4
## 126  1.94591014905531 , 6
## 127  1.94591014905531 , 5
## 128  1.94591014905531 , 4
## 129  1.79175946922805 , 5
## 130  1.94591014905531 , 6
## 131  2.07944154167984 , 6
## 132  2.19722457733622 , 4
## 133  1.79175946922805 , 6
## 134                 0 , 4
## 135   1.6094379124341 , 4
## 136  1.38629436111989 , 5
## 137 0.693147180559945 , 2
## 138  1.09861228866811 , 4
## 139  1.94591014905531 , 4
## 140  1.94591014905531 , 4
## 141  1.94591014905531 , 4
## 142 0.693147180559945 , 5
## 143  2.19722457733622 , 4
## 144  2.07944154167984 , 6
## 145  2.07944154167984 , 6
## 146  2.07944154167984 , 6
## 147  2.07944154167984 , 6
## 148  2.07944154167984 , 6
## 149 0.693147180559945 , 4
## 150                 0 , 2
## 151 0.693147180559945 , 5
## 152  1.09861228866811 , 4
## 153                 0 , 2
## 154  2.07944154167984 , 6
## 155  1.94591014905531 , 4
## 156 0.693147180559945 , 4
## 157  1.38629436111989 , 4
## 158  2.19722457733622 , 9
## 159  1.38629436111989 , 3
## 160                 0 , 2
```

```
## 161  1.94591014905531 , 4
## 162  1.09861228866811 , 4
## 163  1.79175946922805 , 5
## 164  1.09861228866811 , 4
## 165 0.693147180559945 , 4
## 166  1.79175946922805 , 3
## 167  1.79175946922805 , 5
## 168  1.79175946922805 , 4
## 169  2.07944154167984 , 6
## 170 0.693147180559945 , 5
## 171  2.07944154167984 , 6
## 172  1.38629436111989 , 3
## 173  2.07944154167984 , 6
## 174 0.693147180559945 , 5
## 175  1.09861228866811 , 4
## 176  2.07944154167984 , 6
## 177 0.693147180559945 , 5
## 178 0.693147180559945 , 4
## 179  1.94591014905531 , 4
## 180  1.09861228866811 , 5
## 181 0.693147180559945 , 2
## 182  1.94591014905531 , 4
## 183 0.693147180559945 , 4
## 184  1.94591014905531 , 4
## 185                 0 , 2
## 186  2.07944154167984 , 6
## 187  1.09861228866811 , 4
## 188  1.09861228866811 , 4
## 189  1.09861228866811 , 4
## 190  1.94591014905531 , 4
## 191  2.07944154167984 , 6
## 192                 0 , 3
## 193   1.6094379124341 , 4
## 194   1.6094379124341 , 4
## 195  1.38629436111989 , 4
## 196  1.38629436111989 , 4
## 197  1.38629436111989 , 4
## 198  1.79175946922805 , 5
## 199  2.07944154167984 , 6
## 200  1.09861228866811 , 4
## 201  1.09861228866811 , 4
## 202  2.07944154167984 , 6
## 203 0.693147180559945 , 4
## 204   1.6094379124341 , 6
## 205 0.693147180559945 , 5
## 206  1.09861228866811 , 4
## 207  1.94591014905531 , 4
## 208   1.6094379124341 , 4
## 209  1.09861228866811 , 4
## 210  2.07944154167984 , 6
## 211                 0 , 4
## 212  1.79175946922805 , 3
## 213  1.38629436111989 , 4
## 214  1.38629436111989 , 4
```

```
## 215  1.79175946922805 , 5
## 216                 0 , 4
## 217                 0 , 4
## 218  1.79175946922805 , 3
## 219  1.38629436111989 , 3
## 220 0.693147180559945 , 2
## 221                 0 , 2
## 222  1.38629436111989 , 5
## 223 0.693147180559945 , 5
## 224  2.07944154167984 , 6
## 225                 0 , 3
## 226                 0 , 3
## 227  2.07944154167984 , 8
## 228                 0 , 4
## 229 0.693147180559945 , 2
## 230  2.07944154167984 , 6
## 231  2.07944154167984 , 6
## 232  2.07944154167984 , 6
## 233  1.79175946922805 , 6
## 234  1.38629436111989 , 4
## 235                 0 , 2
## 236 0.693147180559945 , 4
## 237 0.693147180559945 , 2
## 238  1.94591014905531 , 4
## 239 0.693147180559945 , 2
## 240 0.693147180559945 , 2
## 241                 0 , 4
## 242  1.38629436111989 , 3
## 243  1.38629436111989 , 3
## 244                 0 , 2
## 245 0.693147180559945 , 2
## 246 0.693147180559945 , 4
## 247  1.79175946922805 , 5
## 248 0.693147180559945 , 2
## 249  1.09861228866811 , 4
## 250  1.38629436111989 , 4
## 251 0.693147180559945 , 2
## 252  2.07944154167984 , 6
## 253 0.693147180559945 , 5
## 254  1.38629436111989 , 3
## 255 0.693147180559945 , 2
## 256                 0 , 2
## 257  1.79175946922805 , 6
## 258  1.38629436111989 , 5
## 259  2.07944154167984 , 5
## 260  2.07944154167984 , 6
## 261  1.38629436111989 , 5
## 262 0.693147180559945 , 4
## 263  1.79175946922805 , 5
## 264  1.79175946922805 , 5
## 265 0.693147180559945 , 4
## 266  2.07944154167984 , 6
## 267  1.38629436111989 , 3
## 268 0.693147180559945 , 4
```

```
## 269  1.94591014905531 , 4
## 270  2.07944154167984 , 6
## 271  1.09861228866811 , 4
## 272  2.07944154167984 , 5
## 273  2.07944154167984 , 5
## 274  1.79175946922805 , 5
## 275  1.94591014905531 , 4
## 276 0.693147180559945 , 2
## 277 0.693147180559945 , 2
## 278 0.693147180559945 , 2
## 279  1.94591014905531 , 4
## 280  1.79175946922805 , 5
## 281  1.94591014905531 , 4
## 282  1.79175946922805 , 3
## 283  1.09861228866811 , 4
## 284  1.79175946922805 , 5
## 285  1.38629436111989 , 4
## 286  2.07944154167984 , 6
## 287  1.94591014905531 , 5
## 288  1.94591014905531 , 5
## 289  1.09861228866811 , 4
## 290  2.07944154167984 , 3
## 291  2.19722457733622 , 4
## 292  2.07944154167984 , 6
## 293 0.693147180559945 , 4
## 294  2.07944154167984 , 6
## 295  2.07944154167984 , 6
## 296  1.09861228866811 , 5
## 297  2.07944154167984 , 6
## 298 0.693147180559945 , 4
## 299  2.07944154167984 , 6
## 300  1.38629436111989 , 5
## 301 0.693147180559945 , 2
## 302  1.79175946922805 , 5
## 303  1.09861228866811 , 4
## 304  1.09861228866811 , 6
## 305                 0 , 3
## 306  1.38629436111989 , 4
## 307 0.693147180559945 , 2
## 308  1.94591014905531 , 4
## 309  1.38629436111989 , 4
## 310  1.38629436111989 , 6
## 311  2.07944154167984 , 6
## 312  2.07944154167984 , 3
## 313  1.79175946922805 , 5
## 314  1.94591014905531 , 4
## 315   1.6094379124341 , 6
## 316  1.09861228866811 , 6
## 317 0.693147180559945 , 5
## 318  1.38629436111989 , 4
## 319                 0 , 5
## 320  1.94591014905531 , 4
## 321  1.94591014905531 , 3
## 322  1.38629436111989 , 4
```

```
## 323 0.693147180559945 , 4
## 324  1.38629436111989 , 3
## 325  2.07944154167984 , 6
## 326 0.693147180559945 , 4
## 327  1.38629436111989 , 5
## 328  1.38629436111989 , 3
## 329  1.09861228866811 , 4
## 330 0.693147180559945 , 5
## 331  1.79175946922805 , 3
## 332   1.6094379124341 , 6
## 333  1.38629436111989 , 5
## 334  1.09861228866811 , 4
## 335   1.6094379124341 , 4
## 336  1.94591014905531 , 4
## 337  1.09861228866811 , 4
## 338  1.94591014905531 , 4
## 339  2.07944154167984 , 6
## 340  1.79175946922805 , 4
## 341                 0 , 4
## 342 0.693147180559945 , 5
## 343  1.09861228866811 , 4
## 344                 0 , 5
## 345  1.94591014905531 , 5
## 346  1.79175946922805 , 4
## 347                 0 , 2
## 348 0.693147180559945 , 5
## 349  1.94591014905531 , 4
## 350  1.94591014905531 , 5
## 351  1.94591014905531 , 5
## 352  1.94591014905531 , 5
## 353  1.38629436111989 , 4
## 354  1.38629436111989 , 5
## 355   1.6094379124341 , 4
## 356  2.07944154167984 , 6
## 357                 0 , 3
## 358  2.07944154167984 , 6
## 359  1.79175946922805 , 5
## 360   1.6094379124341 , 4
## 361  1.38629436111989 , 5
## 362  1.38629436111989 , 5
## 363  1.38629436111989 , 4
## 364 0.693147180559945 , 4
## 365  1.09861228866811 , 4
## 366   1.6094379124341 , 4
## 367  1.94591014905531 , 4
## 368  1.38629436111989 , 4
## 369  1.09861228866811 , 4
## 370  2.07944154167984 , 5
## 371  1.38629436111989 , 4
## 372  1.38629436111989 , 3
## 373                 0 , 2
## 374                 0 , 2
## 375                 0 , 2
## 376  1.38629436111989 , 5
```

```
## 377  1.38629436111989 , 5
## 378 0.693147180559945 , 4
## 379  1.79175946922805 , 4
## 380  1.94591014905531 , 4
## 381  2.19722457733622 , 9
## 382  1.79175946922805 , 3
## 383  1.79175946922805 , 3
## 384  1.38629436111989 , 5
## 385                 0 , 3
## 386  1.94591014905531 , 5
## 387  1.79175946922805 , 5
## 388   1.6094379124341 , 4
## 389  1.09861228866811 , 4
## 390                 0 , 4
## 391  1.94591014905531 , 4
## 392  1.09861228866811 , 4
## 393 0.693147180559945 , 2
## 394                 0 , 2
## 395  1.94591014905531 , 5
## 396  2.07944154167984 , 6
## 397 0.693147180559945 , 5
## 398  2.07944154167984 , 6
## 399 0.693147180559945 , 5
## 400  2.07944154167984 , 6
## 401  1.79175946922805 , 3
## 402                 0 , 4
## 403  1.79175946922805 , 3
## 404                 0 , 5
## 405 0.693147180559945 , 4
## 406   1.6094379124341 , 4
## 407 0.693147180559945 , 4
## 408   1.6094379124341 , 4
## 409  1.79175946922805 , 3
## 410  1.09861228866811 , 4
## 411 0.693147180559945 , 4
## 412  1.79175946922805 , 5
## 413  1.79175946922805 , 3
## 414                 0 , 2
## 415  1.09861228866811 , 5
## 416  1.38629436111989 , 4
## 417  1.38629436111989 , 6
## 418                 0 , 5
## 419  1.79175946922805 , 3
## 420  1.38629436111989 , 3
## 421  1.94591014905531 , 4
## 422  1.09861228866811 , 4
## 423  1.94591014905531 , 4
## 424  1.38629436111989 , 4
## 425 0.693147180559945 , 5
## 426  1.94591014905531 , 4
## 427  2.07944154167984 , 6
## 428                 0 , 3
## 429  1.38629436111989 , 5
## 430  1.38629436111989 , 4
```

```
## 431  1.79175946922805 , 5
## 432  1.79175946922805 , 5
## 433                 0 , 3
## 434                 0 , 2
## 435   1.6094379124341 , 4
## 436  1.09861228866811 , 4
## 437   1.6094379124341 , 4
## 438   1.6094379124341 , 4
## 439  1.38629436111989 , 4
## 440  1.94591014905531 , 4
## 441  1.94591014905531 , 4
## 442  1.94591014905531 , 4
## 443  1.38629436111989 , 4
## 444  1.38629436111989 , 4
## 445  1.09861228866811 , 4
## 446  1.38629436111989 , 3
## 447                 0 , 4
## 448   1.6094379124341 , 4
## 449  1.79175946922805 , 5
## 450  1.79175946922805 , 5
## 451  1.38629436111989 , 3
## 452  1.09861228866811 , 3
## 453                 0 , 2
## 454 0.693147180559945 , 4
## 455                 0 , 2
## 456  1.79175946922805 , 5
## 457   1.6094379124341 , 4
## 458  2.19722457733622 , 6
## 459 0.693147180559945 , 2
## 460  2.07944154167984 , 6
## 461  1.09861228866811 , 4
## 462 0.693147180559945 , 4
## 463 0.693147180559945 , 4
## 464 0.693147180559945 , 4
## 465  1.94591014905531 , 4
## 466  1.79175946922805 , 3
## 467 0.693147180559945 , 3
## 468  1.38629436111989 , 3
## 469  1.94591014905531 , 4
## 470  1.79175946922805 , 3
## 471  2.07944154167984 , 6
## 472 0.693147180559945 , 4
## 473 0.693147180559945 , 5
## 474  2.07944154167984 , 6
## 475  2.07944154167984 , 6
## 476  1.38629436111989 , 3
## 477  1.79175946922805 , 5
## 478  1.79175946922805 , 5
## 479  1.79175946922805 , 5
## 480  1.38629436111989 , 4
## 481  1.79175946922805 , 5
## 482   1.6094379124341 , 4
## 483  1.79175946922805 , 3
## 484                 0 , 4
```

```
## 485  1.79175946922805 , 5
## 486  1.79175946922805 , 3
## 487  1.79175946922805 , 3
## 488                 0 , 4
## 489  1.79175946922805 , 5
## 490  1.38629436111989 , 3
## 491  1.94591014905531 , 4
## 492  1.38629436111989 , 4
## 493  2.07944154167984 , 6
## 494  1.38629436111989 , 5
## 495  1.79175946922805 , 3
## 496  2.07944154167984 , 6
## 497  1.79175946922805 , 3
## 498 0.693147180559945 , 2
## 499                 0 , 4
## 500                 0 , 4
## 501  1.38629436111989 , 5
## 502  1.38629436111989 , 5
## 503  1.09861228866811 , 4
## 504  2.07944154167984 , 4
## 505  1.94591014905531 , 4
## 506  1.09861228866811 , 5
## 507  1.38629436111989 , 5
## 508  1.94591014905531 , 4
## 509                 0 , 3
## 510                 0 , 4
## 511  1.94591014905531 , 4
## 512  1.94591014905531 , 4
## 513  1.79175946922805 , 5
## 514  1.38629436111989 , 3
## 515   1.6094379124341 , 4
## 516 0.693147180559945 , 5
## 517  1.79175946922805 , 5
```

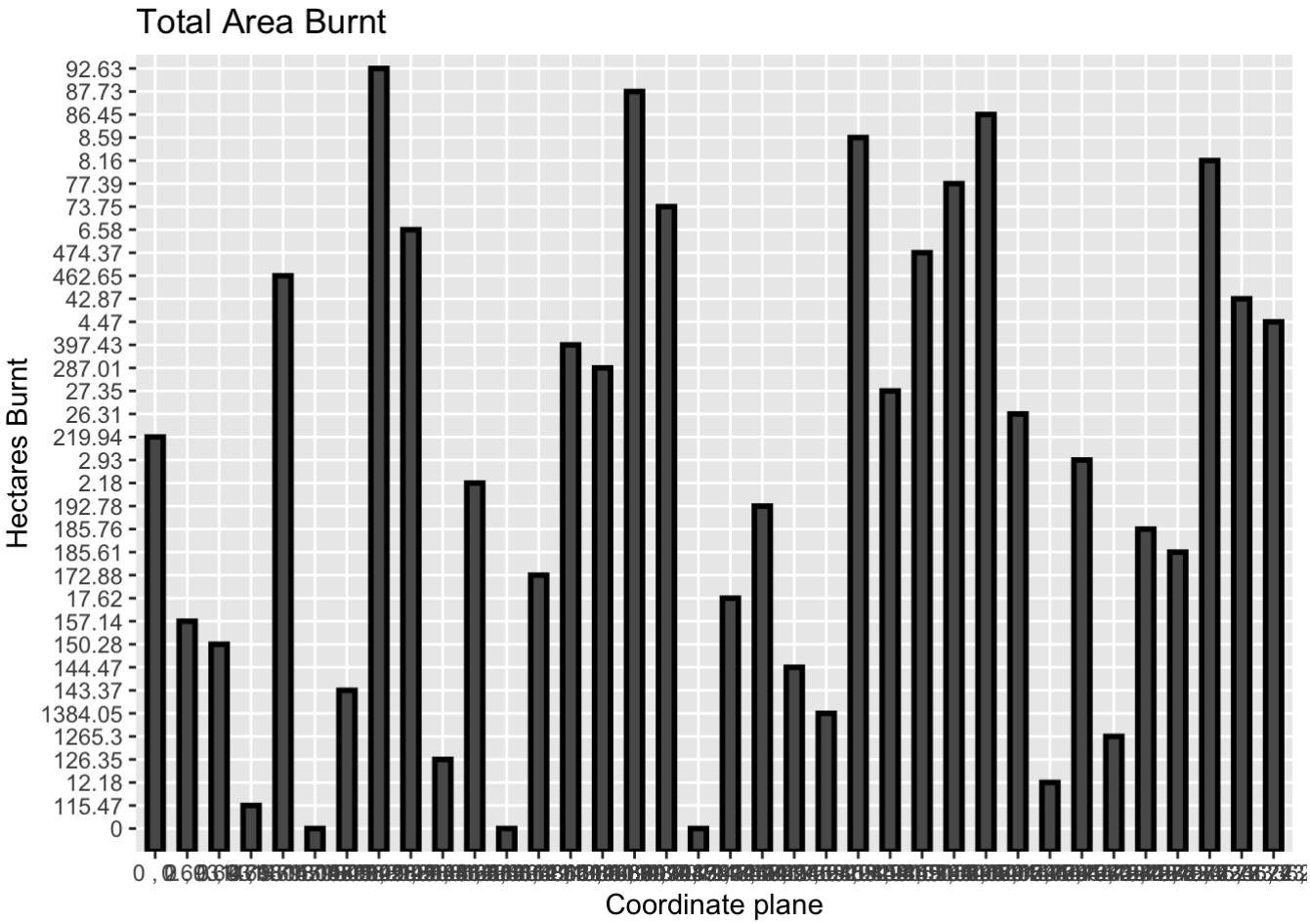
```
ff2 <- cbind(ForestFiresWith ,df)
ff2 <- as.data.frame(ff2)
## no need to X and Y columns when we have x,y column
ff2 <- ff2[,c(5:15)]
str(ff2)
```

```
## 'data.frame':    517 obs. of  11 variables:
##  $ FFMC             : num  81.9 82.1 79.5 69 85.2 75.1 75.1 86.9 93.4 91 ...
##  $ DMC              : num  3 3.7 3.6 2.4 4.9 4.4 4.4 6.6 15 14.6 ...
##  $ DC               : num  7.9 9.3 15.3 15.5 15.8 16.2 16.2 18.7 25.6 25.6 ...
##  $ ISI              : num  3.5 2.9 1.8 0.7 6.3 1.9 1.9 3.2 11.4 12.3 ...
##  $ temperature      : num  13.4 5.3 4.6 17.4 7.5 4.6 5.1 8.8 15.2 13.7 ...
##  $ relative humidity: num  75 78 59 24 46 82 77 35 19 33 ...
##  $ wind speeds      : num  1.8 3.1 0.9 5.4 8 6.3 5.4 3.1 7.6 9.4 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ area             : num  0 0 6.84 0 24.24 ...
##  $ fire__no_yes     : num  0 0 1 0 1 1 1 1 0 1 ...
##  $ coordinates      : Factor w/ 36 levels "0 , 2","0 , 3",..: 26 7 5 10 17 22 21 10 7
20 ...
```

```
View(ff2)
## Using tapply to sum up the total area burn per coordinate X,Y
areaburnedbycoord <- tapply(ff2$area, ff2$coordinates, FUN = sum)
areaburnedbycoord <- cbind(coordinates = rownames(areaburnedbycoord), areaburnedbycoord)
colnames(areaburnedbycoord) <- c("coordinates", "total_area_burned")
areaburnedbycoord <- as.data.frame(areaburnedbycoord)
summary(areaburnedbycoord)
```

```
##                 coordinates total_area_burned
##  0 , 2                : 1   0      : 3
##  0 , 3                : 1   115.47 : 1
##  0 , 4                : 1   12.18  : 1
##  0 , 5                : 1   126.35 : 1
##  0.693147180559945 , 2: 1   1265.3 : 1
##  0.693147180559945 , 3: 1   1384.05: 1
##  (Other)              :30   (Other):28
```

```
barburn <- ggplot(data = areaburnedbycoord, aes(x= areaburnedbycoord$coordinates, y = ar
eaburnedbycoord$total_area_burned))
barburn <- barburn + geom_bar(stat = "identity", width = .5, color = "black", size =1)
barburn <- barburn + ggtitle("Total Area Burnt")  + labs(y="Hectares Burnt", x = "Coordi
nate plane")
barburn
```




```
##This code did not work
## Using tapply to sum up the total times there was a fire per coordinate X,Y
##ff2 <- ff2 %>% filter(ff2$fire__no_yes != 0)
##str(ff2)
##freqofburnedarea <- tapply(as.numeric(ff2$fire__no_yes), ff2$coordinates, FUN = lengt
h)
##freqofburnedarea <- cbind(coordinates = rownames(freqofburnedarea), freqofburnedarea)
##colnames(freqofburnedarea) <- cbind("coordinates", "freq_of_fires")


freqofburnedarea <- ff2[1:36,1:2]
colnames(freqofburnedarea) <- cbind("coordinates", "freq_of_fires")
summary(freqofburnedarea)
```

```
##   coordinates    freq_of_fires
##  Min.   :69.00   Min.   : 2.400
##  1st Qu.:83.90   1st Qu.: 6.175
##  Median :85.10   Median : 9.200
##  Mean   :85.44   Mean   :11.358
##  3rd Qu.:88.55   3rd Qu.:17.225
##  Max.   :93.40   Max.   :24.900
```

```
sum(freqofburnedarea$freq_of_fires)
```

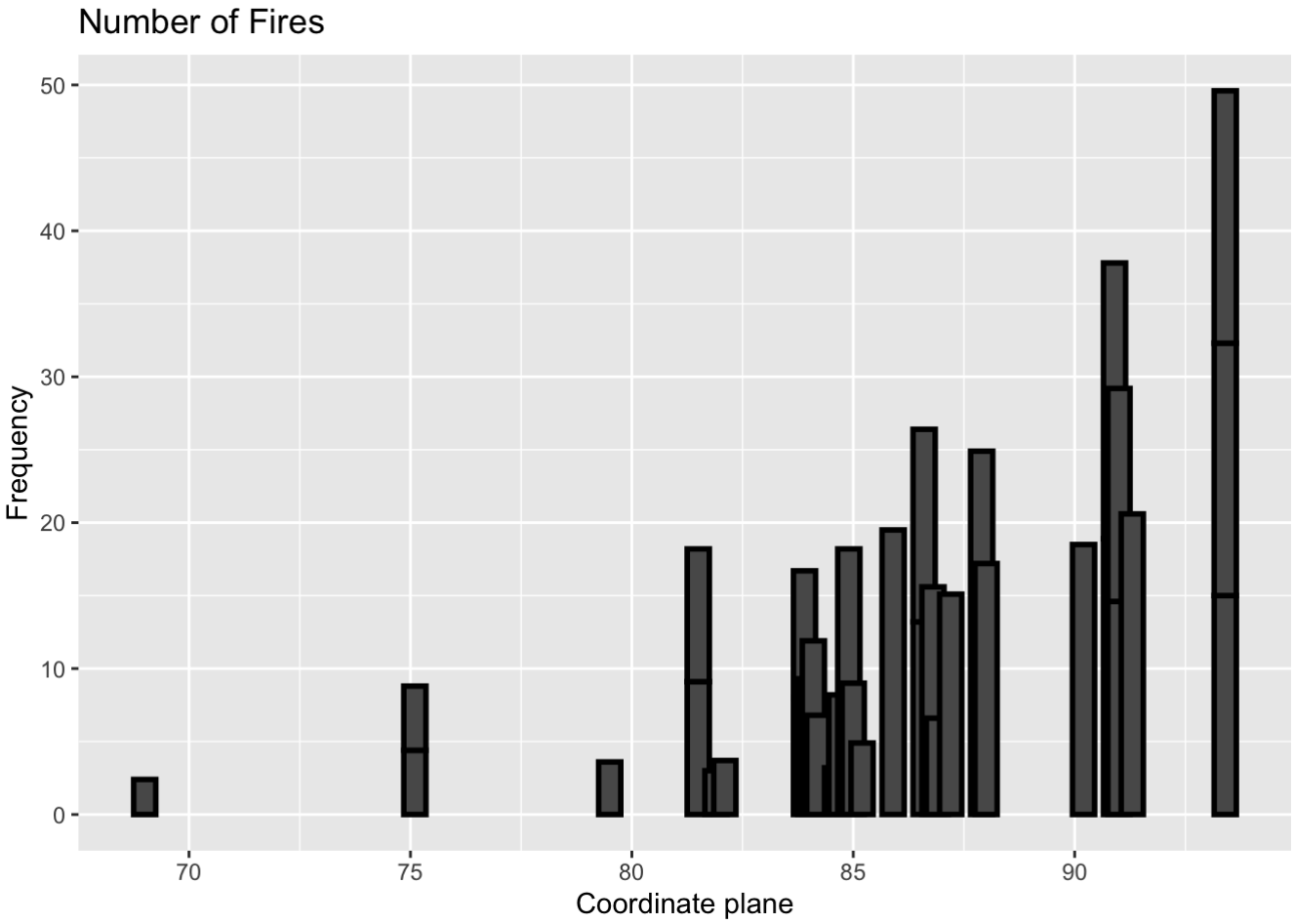
```
## [1] 408.9
```

```
sum(ff2$fire__no_yes)
```

```
## [1] 270
```

```
barfreq <- ggplot(data = freqofburnedarea, aes(x= freqofburnedarea$coordinates, y = freq
ofburnedarea$freq_of_fires))
barfreq <- barfreq + geom_bar(stat = "identity", width = .5, color = "black", size =1)
barfreq <- barfreq + ggtitle("Number of Fires")  + labs(y="Frequency", x = "Coordinate p
lane")
barfreq
```

```
## Warning: position_stack requires non-overlapping x intervals
```




```
# Decistion Tree
ff3 <- ff2[,-c(9,11)]
View(ff3)
ff3
```

```
##     FFMC   DMC    DC  ISI temperature relative humidity wind speeds
## 1   81.9   3.0   7.9  3.5        13.4                75         1.8
## 2   82.1   3.7   9.3  2.9         5.3                78         3.1
## 3   79.5   3.6  15.3  1.8         4.6                59         0.9
## 4   69.0   2.4  15.5  0.7        17.4                24         5.4
## 5   85.2   4.9  15.8  6.3         7.5                46         8.0
## 6   75.1   4.4  16.2  1.9         4.6                82         6.3
## 7   75.1   4.4  16.2  1.9         5.1                77         5.4
## 8   86.9   6.6  18.7  3.2         8.8                35         3.1
## 9   93.4  15.0  25.6 11.4        15.2                19         7.6
## 10  91.0  14.6  25.6 12.3        13.7                33         9.4
## 11  91.0  14.6  25.6 12.3        17.6                27         5.8
## 12  84.2   6.8  26.6  7.7         6.7                79         3.1
## 13  93.4  17.3  28.3  9.9        13.8                24         5.8
## 14  93.4  17.3  28.3  9.9         8.9                35         8.0
## 15  83.9   8.0  30.2  2.6        12.7                48         1.8
## 16  90.9  18.9  30.6  8.0         8.7                51         5.8
## 17  90.9  18.9  30.6  8.0        11.6                48         5.4
## 18  83.9   8.7  32.1  2.1         8.8                68         2.2
## 19  84.0   9.3  34.0  2.1        13.9                40         5.4
## 20  87.2  15.1  36.9  7.1        10.2                45         5.8
## 21  90.2  18.5  41.1  7.3        11.2                41         5.4
## 22  87.9  24.9  41.6  3.7        10.9                64         3.1
## 23  86.6  13.2  43.0  5.3        12.3                51         0.9
## 24  86.6  13.2  43.0  5.3        15.7                43         3.1
## 25  88.0  17.2  43.5  3.8        15.2                51         2.7
## 26  91.3  20.6  43.5  8.5        13.3                27         3.6
## 27  84.6   3.2  43.6  3.3         8.2                53         9.4
## 28  84.1   4.6  46.7  2.2         5.3                68         1.8
## 29  86.8  15.6  48.3  3.9        12.4                53         2.2
## 30  84.1   7.3  52.8  2.7        14.7                42         2.7
## 31  84.9  18.2  55.0  3.0         5.3                70         4.5
## 32  84.7   8.2  55.0  2.9        14.2                46         4.0
## 33  81.5   9.1  55.2  2.7         5.8                54         5.8
## 34  81.5   9.1  55.2  2.7         5.8                54         5.8
## 35  85.0   9.0  56.9  3.5        10.1                62         1.8
## 36  85.9  19.5  57.3  2.8        12.7                52         6.3
## 37  85.9  19.5  57.3  2.8        13.7                43         5.8
## 38  84.7   9.5  58.3  4.1         7.5                71         6.3
## 39  87.2  23.9  64.7  4.1        11.8                35         1.8
## 40  87.2  23.9  64.7  4.1        14.0                39         3.1
## 41  88.1  25.7  67.6  3.8        14.1                43         2.7
## 42  88.1  25.7  67.6  3.8        15.8                27         7.6
## 43  88.1  25.7  67.6  3.8        15.5                27         6.3
## 44  88.1  25.7  67.6  3.8        14.9                38         2.7
## 45  89.2  27.9  70.8  6.3        15.9                35         4.0
## 46  89.6  25.4  73.7  5.7        18.0                40         4.0
## 47  91.4  30.7  74.3  7.5        18.2                29         3.1
## 48  91.7  33.3  77.5  9.0        17.2                26         4.5
## 49  91.7  33.3  77.5  9.0        15.6                25         6.3
## 50  91.7  33.3  77.5  9.0        18.8                18         4.5
## 51  91.7  33.3  77.5  9.0         8.3                97         4.0
## 52  91.7  35.8  80.8  7.8        15.1                27         5.4
```

```
## 53  91.7  35.8  80.8  7.8        17.4                25         4.9
## 54  91.7  35.8  80.8  7.8        17.4                24         5.4
## 55  91.7  35.8  80.8  7.8        11.6                30         6.3
## 56  91.7  35.8  80.8  7.8        15.2                27         4.9
## 57  91.7  35.8  80.8  7.8        17.0                27         4.9
## 58  91.7  35.8  80.8  7.8        17.0                27         4.9
## 59  90.1  37.6  83.7  7.2        12.4                54         3.6
## 60  83.0  23.3  85.3  2.3        16.7                20         3.1
## 61  90.1  39.7  86.6  6.2        10.6                30         4.0
## 62  90.1  39.7  86.6  6.2        13.2                40         5.4
## 63  90.1  39.7  86.6  6.2        16.1                29         3.1
## 64  90.1  39.7  86.6  6.2        15.2                27         3.1
## 65  68.2  21.5  87.2  0.8        15.4                40         2.7
## 66  90.8  41.9  89.4  7.9        13.3                42         0.9
## 67  90.7  44.0  92.4  5.5        11.5                60         4.0
## 68  86.2  26.2  94.3  5.1         8.2                51         6.7
## 69  86.3  27.4  97.1  5.1         9.3                44         4.5
## 70  91.2  48.3  97.8 12.5        15.8                27         7.6
## 71  91.2  48.3  97.8 12.5        14.6                26         9.4
## 72  91.2  48.3  97.8 12.5        11.7                33         4.0
## 73  90.6  50.1 100.4  7.8        15.2                31         8.5
## 74  90.6  50.1 100.4  7.8        15.1                64         4.0
## 75  94.0  47.9 100.7 10.7        17.3                80         4.5
## 76  89.3  51.3 102.2  9.6        11.4                99         1.8
## 77  89.3  51.3 102.2  9.6        11.5                39         5.8
## 78  89.3  51.3 102.2  9.6         5.5                59         6.3
## 79  89.3  51.3 102.2  9.6        10.6                46         4.9
## 80  89.3  51.3 102.2  9.6        11.5                39         5.8
## 81  87.6  52.2 103.8  5.0        11.0                46         5.8
## 82  87.6  52.2 103.8  5.0         8.3                72         3.1
## 83  87.6  52.2 103.8  5.0         9.0                49         2.2
## 84  87.6  52.2 103.8  5.0        11.0                46         5.8
## 85  87.6  52.2 103.8  5.0        11.0                46         5.8
## 86  79.5   3.0 106.7  1.1        11.8                31         4.5
## 87  85.1  28.0 113.8  3.5        11.3                94         4.9
## 88  18.7   1.1 171.4  0.0         5.2               100         0.9
## 89  94.3  96.3 200.0 56.1        21.0                44         4.5
## 90  88.2  96.2 229.0  4.7        14.3                79         4.0
## 91  91.1  94.1 232.1  7.1        19.2                38         4.5
## 92  91.1  94.1 232.1  7.1        19.2                38         4.5
## 93  53.4  71.0 233.8  0.4        10.6                90         2.7
## 94  90.5  61.1 252.6  9.4        24.5                50         3.1
## 95  90.4  89.5 290.8  6.4        14.3                46         1.8
## 96  90.4  89.5 290.8  6.4        15.4                45         2.2
## 97  90.0  51.3 296.3  8.7        16.6                53         5.4
## 98  93.3  49.5 297.7 14.0        28.0                34         4.5
## 99  93.3  49.5 297.7 14.0        28.0                34         4.5
## 100 90.4  93.3 298.1  7.5        20.7                25         4.9
## 101 90.4  93.3 298.1  7.5        19.1                39         5.4
## 102 88.3 150.3 309.9  6.8        13.4                79         3.6
## 103 85.8  48.3 313.4  3.9        18.0                42         2.7
## 104 93.0 103.8 316.7 10.8        26.4                35         2.7
## 105 85.4  25.4 349.7  2.6         4.6                21         8.5
## 106 85.4  25.4 349.7  2.6         4.6                21         8.5
```

```
## 107 85.4  25.4 349.7  2.6         4.6                21         8.5
## 108 85.4  25.4 349.7  2.6         4.6                21         8.5
## 109 85.4  25.4 349.7  2.6         5.1                24         8.5
## 110 93.7 121.7 350.2 18.0        22.7                40         9.4
## 111 84.6  26.4 352.0  2.0         5.1                61         4.9
## 112 84.7  26.7 352.6  4.1         2.2                59         4.9
## 113 84.4  27.2 353.5  6.8         4.8                57         8.5
## 114 84.9  27.5 353.5  3.4         4.2                51         4.0
## 115 84.0  27.8 354.6  5.3         5.1                61         8.0
## 116 90.1  68.6 355.2  7.2        24.8                29         2.2
## 117 79.5  60.6 366.7  1.5        23.3                37         3.1
## 118 90.7  80.9 368.3 16.8        14.8                78         8.0
## 119 90.8  84.7 376.6  5.6        23.8                51         1.8
## 120 91.2 147.8 377.2 12.7        19.6                43         4.9
## 121 93.5  85.3 395.0  9.9        27.2                28         1.3
## 122 93.9 169.7 411.8 12.3        23.4                40         6.3
## 123 93.7 101.3 423.4 14.7        26.1                45         4.0
## 124 93.7 101.3 423.4 14.7        18.2                82         4.5
## 125 90.1  51.2 424.1  6.2        24.6                43         1.8
## 126 93.1 180.4 430.8 11.0        26.9                28         5.4
## 127 93.1 180.4 430.8 11.0        22.2                48         1.3
## 128 89.2 103.9 431.6  6.4        22.6                57         4.9
## 129 92.5  56.4 433.3  7.1        23.2                39         5.4
## 130 91.2 183.1 437.7 12.5        12.6                90         7.6
## 131 92.3  88.8 440.9  8.5        17.1                67         3.6
## 132 92.3  92.1 442.1  9.8        22.8                27         4.5
## 133 94.2  62.3 442.9 11.0        23.0                36         3.1
## 134 92.3  96.2 450.2 12.1        23.4                31         5.4
## 135 93.7 101.3 458.8 11.9        19.3                39         7.2
## 136 91.6 100.2 466.3  6.3        22.9                40         1.3
## 137 93.0  75.3 466.6  7.7        18.8                35         4.9
## 138 93.0  75.3 466.6  7.7        19.6                36         3.1
## 139 91.6 104.2 474.9  9.0        22.1                49         2.7
## 140 91.6 104.2 474.9  9.0        24.2                32         1.8
## 141 91.6 104.2 474.9  9.0        24.3                30         1.8
## 142 91.6 104.2 474.9  9.0        18.7                53         1.8
## 143 91.6 104.2 474.9  9.0        25.3                39         0.9
## 144 92.2  81.8 480.8 11.9        20.1                34         4.5
## 145 92.2  81.8 480.8 11.9        16.4                43         4.0
## 146 92.3  85.3 488.0 14.7        22.2                29         5.4
## 147 92.3  85.3 488.0 14.7        20.8                32         6.3
## 148 92.3  88.9 495.6  8.5        24.1                27         3.1
## 149 92.2  91.6 503.6  9.6        20.7                70         2.2
## 150 95.5  99.9 513.3 13.2        23.3                31         4.5
## 151 95.5  99.9 513.3 13.2        23.8                32         5.4
## 152 91.9 133.6 520.5  8.0        14.2                58         4.0
## 153 90.1 108.0 529.8 12.5        14.7                66         2.7
## 154 90.1 108.0 529.8 12.5        21.2                51         8.9
## 155 90.2 110.9 537.4  6.2        19.5                43         5.8
## 156 93.6  97.9 542.0 14.4        28.3                32         4.0
## 157 93.7 102.2 550.3 14.6        22.1                54         7.6
## 158 93.2 114.4 560.0  9.5        30.2                25         4.5
## 159 93.2 114.4 560.0  9.5        30.2                22         4.9
## 160 91.0 121.2 561.6  7.0        21.6                19         6.7
```

```
## 161 91.9 109.2 565.5  8.0        21.4                38         2.7
## 162 94.6 160.0 567.2 16.7        17.9                48         2.7
## 163 96.0 127.1 570.5 16.5        23.4                33         4.5
## 164 91.6 112.4 573.0  8.9        11.2                84         7.6
## 165 91.6 112.4 573.0  8.9        21.4                42         3.1
## 166 92.7 164.1 575.8  8.9        26.3                39         3.1
## 167 95.2 131.7 578.8 10.4        27.4                22         4.0
## 168 95.2 131.7 578.8 10.4        20.3                41         4.0
## 169 95.2 131.7 578.8 10.4        20.7                45         2.2
## 170 95.2 131.7 578.8 10.4        24.2                28         2.7
## 171 94.2 117.2 581.1 11.0        23.9                41         2.2
## 172 94.2 117.2 581.1 11.0        21.4                44         2.7
## 173 93.9 135.7 586.7 15.1        20.8                34         4.9
## 174 93.9 135.7 586.7 15.1        23.5                36         5.4
## 175 94.9 130.3 587.1 14.1        23.4                40         5.8
## 176 94.9 130.3 587.1 14.1        31.0                27         5.4
## 177 94.9 130.3 587.1 14.1        33.1                25         4.0
## 178 94.2 122.3 589.9 12.9        15.4                66         4.0
## 179 93.5 139.4 594.2 20.3        23.7                32         5.8
## 180 93.5 139.4 594.2 20.3        17.6                52         5.8
## 181 93.5 139.4 594.2 20.3        22.9                31         7.2
## 182 93.5 139.4 594.2 20.3         5.1                96         5.8
## 183 95.0 135.5 596.3 21.3        30.6                28         3.6
## 184 91.4 142.4 601.4 10.6        16.3                60         5.4
## 185 91.4 142.4 601.4 10.6        19.5                39         6.3
## 186 91.4 142.4 601.4 10.6        18.2                43         4.9
## 187 91.4 142.4 601.4 10.6        11.6                87         4.5
## 188 91.4 142.4 601.4 10.6        19.8                39         5.4
## 189 91.4 142.4 601.4 10.6        19.8                39         5.4
## 190 91.4 142.4 601.4 10.6        20.1                39         5.4
## 191 91.4 142.4 601.4 10.6        19.6                41         5.8
## 192 92.1 178.0 605.3  9.6        23.3                40         4.0
## 193 95.1 141.3 605.8 17.7        24.1                43         6.3
## 194 95.1 141.3 605.8 17.7        26.4                34         3.6
## 195 95.1 141.3 605.8 17.7        19.4                71         7.6
## 196 95.1 141.3 605.8 17.7        20.6                58         1.3
## 197 95.1 141.3 605.8 17.7        28.7                33         4.0
## 198 94.3 131.7 607.1 22.7        19.4                55         4.0
## 199 91.5 145.4 608.2 10.7         8.0                86         2.2
## 200 91.5 145.4 608.2 10.7        10.3                74         2.2
## 201 91.5 145.4 608.2 10.7        17.1                43         5.4
## 202 85.6  90.4 609.6  6.6        17.4                50         4.0
## 203 91.6 181.3 613.0  7.6        20.9                50         2.2
## 204 91.6 181.3 613.0  7.6        24.3                33         3.6
## 205 91.6 181.3 613.0  7.6        24.8                36         4.0
## 206 91.6 181.3 613.0  7.6        24.6                44         4.0
## 207 91.6 181.3 613.0  7.6        19.3                61         4.9
## 208 88.8 147.3 614.5  9.0        17.3                43         4.5
## 209 88.8 147.3 614.5  9.0        14.4                66         5.4
## 210 88.8 147.3 614.5  9.0        14.4                66         5.4
## 211 94.4 146.0 614.7 11.3        25.6                42         4.0
## 212 91.6 138.1 621.7  6.3        18.9                41         3.1
## 213 95.8 152.0 624.1 13.8        32.4                21         4.5
## 214 90.2  96.9 624.2  8.9        18.4                42         6.7
```

```
## 215 90.2  96.9 624.2  8.9        14.7                59         5.8
## 216 90.2  96.9 624.2  8.9        14.2                53         1.8
## 217 90.2  96.9 624.2  8.9        20.3                39         4.9
## 218 91.1 141.1 629.1  7.1        19.3                39         3.6
## 219 90.2  99.6 631.2  6.3        21.5                34         2.2
## 220 90.2  99.6 631.2  6.3        20.8                33         2.7
## 221 90.2  99.6 631.2  6.3        17.9                44         2.2
## 222 90.2  99.6 631.2  6.3        21.4                33         3.1
## 223 90.2  99.6 631.2  6.3        19.2                44         2.7
## 224 90.2  99.6 631.2  6.3        16.2                59         3.1
## 225 95.9 158.0 633.6 11.3        32.4                27         2.2
## 226 95.9 158.0 633.6 11.3        27.5                29         4.5
## 227 91.7 191.4 635.9  7.8        26.2                36         4.5
## 228 91.7 191.4 635.9  7.8        19.9                50         4.0
## 229 91.1 103.2 638.8  5.8        23.1                31         3.1
## 230 91.1 103.2 638.8  5.8        23.4                22         2.7
## 231 90.7 194.1 643.0  6.8        16.2                63         2.7
## 232 90.7 194.1 643.0  6.8        21.3                41         3.6
## 233 96.0 164.0 643.0 14.0        30.8                30         4.9
## 234 94.8 108.3 647.1 17.0        16.6                54         5.4
## 235 94.8 108.3 647.1 17.0        18.6                51         4.5
## 236 94.8 108.3 647.1 17.0        20.1                40         4.0
## 237 94.8 108.3 647.1 17.0        17.4                43         6.7
## 238 94.8 108.3 647.1 17.0        16.4                47         1.3
## 239 94.8 108.3 647.1 17.0        24.6                22         4.5
## 240 94.8 108.3 647.1 17.0        24.6                22         4.5
## 241 90.5 196.8 649.9 16.3        11.8                88         4.9
## 242 92.1 111.2 654.1  9.6        20.4                42         4.9
## 243 92.1 111.2 654.1  9.6        20.4                42         4.9
## 244 92.1 111.2 654.1  9.6        16.6                47         0.9
## 245 92.1 111.2 654.1  9.6        18.4                45         3.6
## 246 92.1 111.2 654.1  9.6        20.5                35         4.0
## 247 92.1 111.2 654.1  9.6        16.6                47         0.9
## 248 92.1 152.6 658.2 14.3        23.7                24         3.1
## 249 92.1 152.6 658.2 14.3        21.0                32         3.1
## 250 92.1 152.6 658.2 14.3        19.1                53         2.7
## 251 92.1 152.6 658.2 14.3        21.8                56         3.1
## 252 92.1 152.6 658.2 14.3        20.1                58         4.5
## 253 92.1 152.6 658.2 14.3        20.2                47         4.0
## 254 91.7 114.3 661.3  6.3        17.6                45         3.6
## 255 91.7 114.3 661.3  6.3        18.6                44         4.5
## 256 91.7 114.3 661.3  6.3        20.2                45         3.6
## 257 96.2 175.5 661.8 16.8        23.9                42         2.2
## 258 96.2 175.5 661.8 16.8        32.6                26         3.1
## 259 84.9  32.8 664.2  3.0        16.7                47         4.9
## 260 84.9  32.8 664.2  3.0        19.1                32         4.0
## 261 92.0 203.2 664.5  8.1        10.4                75         0.9
## 262 92.0 203.2 664.5  8.1        24.9                42         5.4
## 263 92.0 203.2 664.5  8.1        19.1                70         2.2
## 264 63.5  70.8 665.3  0.8        17.0                72         6.7
## 265 63.5  70.8 665.3  0.8        22.6                38         3.6
## 266 81.6  56.7 665.6  1.9        27.8                35         2.7
## 267 81.6  56.7 665.6  1.9        27.8                32         2.7
## 268 81.6  56.7 665.6  1.9        21.9                71         5.8
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## 269 81.6  56.7 665.6  1.9        21.2                70         6.7
## 270 93.1 157.3 666.7 13.5        28.7                28         2.7
## 271 93.1 157.3 666.7 13.5        21.7                40         0.4
## 272 93.1 157.3 666.7 13.5        26.8                25         3.1
## 273 93.1 157.3 666.7 13.5        24.0                36         3.1
## 274 93.1 157.3 666.7 13.5        22.1                37         3.6
## 275 92.4 117.9 668.0 12.2        19.0                34         5.8
## 276 92.4 117.9 668.0 12.2        23.0                37         4.5
## 277 92.4 117.9 668.0 12.2        19.6                33         5.4
## 278 92.4 117.9 668.0 12.2        19.6                33         6.3
## 279 92.4 117.9 668.0 12.2        19.0                34         5.8
## 280 92.4 117.9 668.0 12.2        19.6                33         6.3
## 281 90.6  35.4 669.1  6.7        18.0                33         0.9
## 282 90.6  35.4 669.1  6.7        21.7                24         4.5
## 283 96.1 181.1 671.2 14.3        32.3                27         2.2
## 284 96.1 181.1 671.2 14.3        33.3                26         2.7
## 285 96.1 181.1 671.2 14.3        20.7                69         4.9
## 286 96.1 181.1 671.2 14.3        21.6                65         4.9
## 287 96.1 181.1 671.2 14.3        21.6                65         4.9
## 288 96.1 181.1 671.2 14.3        27.3                63         4.9
## 289 84.4  73.4 671.9  3.2        17.9                45         3.1
## 290 84.4  73.4 671.9  3.2        24.2                28         3.6
## 291 84.4  73.4 671.9  3.2        24.3                36         3.1
## 292 92.1 207.0 672.6  8.2        21.1                54         2.2
## 293 92.1 207.0 672.6  8.2        27.9                33         2.2
## 294 92.1 207.0 672.6  8.2        26.8                35         1.3
## 295 92.1 207.0 672.6  8.2        25.5                29         1.8
## 296 91.4  37.9 673.8  5.2        15.9                46         3.6
## 297 91.4  37.9 673.8  5.2        20.2                37         2.7
## 298 92.5 121.1 674.4  8.6        24.1                29         4.5
## 299 92.5 121.1 674.4  8.6        17.8                56         1.8
## 300 92.5 121.1 674.4  8.6        17.7                25         3.1
## 301 92.5 121.1 674.4  8.6        18.2                46         1.8
## 302 92.5 121.1 674.4  8.6        25.1                27         4.0
## 303 92.4 124.1 680.7  8.5        22.5                42         5.4
## 304 92.4 124.1 680.7  8.5        17.2                58         1.3
## 305 92.4 124.1 680.7  8.5        23.9                32         6.7
## 306 92.4 124.1 680.7  8.5        16.9                60         1.3
## 307 94.6 212.1 680.9  9.5        27.9                27         2.2
## 308 90.0  41.5 682.6  8.7        11.3                60         5.4
## 309 94.3 167.6 684.4 13.0        21.8                53         3.1
## 310 93.7  80.9 685.2 17.9        17.6                42         3.1
## 311 93.7  80.9 685.2 17.9        23.7                25         4.5
## 312 93.7  80.9 685.2 17.9        23.2                26         4.9
## 313 90.9 126.5 686.5  7.0        21.3                42         2.2
## 314 90.9 126.5 686.5  7.0        19.4                48         1.3
## 315 90.9 126.5 686.5  7.0        14.7                70         3.6
## 316 90.9 126.5 686.5  7.0        15.6                66         3.1
## 317 90.9 126.5 686.5  7.0        21.9                39         1.8
## 318 90.9 126.5 686.5  7.0        17.7                39         2.2
## 319 90.9 126.5 686.5  7.0        21.0                42         2.2
## 320 90.6  43.7 686.9  6.7        14.6                33         1.3
## 321 90.6  43.7 686.9  6.7        17.8                27         4.0
## 322 90.6  43.7 686.9  6.7        18.4                25         3.1
```

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## 323 94.5 139.4 689.1 20.0        29.2                30         4.9
## 324 94.5 139.4 689.1 20.0        28.9                29         4.9
## 325 95.2 217.7 690.0 18.0        28.2                29         1.8
## 326 95.2 217.7 690.0 18.0        30.8                19         4.5
## 327 95.2 217.7 690.0 18.0        23.4                49         5.4
## 328 92.6  46.5 691.8  8.8        13.8                50         2.7
## 329 92.6  46.5 691.8  8.8        20.6                24         5.4
## 330 92.6  46.5 691.8  8.8        15.4                35         0.9
## 331 94.3  85.1 692.3 15.9        25.4                24         3.6
## 332 94.3  85.1 692.3 15.9        25.9                24         4.0
## 333 94.3  85.1 692.3 15.9        17.7                37         3.6
## 334 94.3  85.1 692.3 15.9        19.8                50         5.4
## 335 94.3  85.1 692.3 15.9        20.1                47         4.9
## 336 94.3  85.1 692.3 15.9        20.1                47         4.9
## 337 91.8 170.9 692.3 13.7        20.6                59         0.9
## 338 91.8 170.9 692.3 13.7        23.7                40         1.8
## 339 91.0 129.5 692.6  7.0        13.1                63         5.4
## 340 91.0 129.5 692.6  7.0        18.3                40         2.7
## 341 91.0 129.5 692.6  7.0        21.7                38         2.2
## 342 91.0 129.5 692.6  7.0        17.6                46         3.1
## 343 91.0 129.5 692.6  7.0        13.9                59         6.3
## 344 91.0 129.5 692.6  7.0        21.6                33         2.2
## 345 91.0 129.5 692.6  7.0        20.7                37         2.2
## 346 91.0 129.5 692.6  7.0        18.7                43         2.7
## 347 91.0 129.5 692.6  7.0        18.8                40         2.2
## 348 87.5  77.0 694.8  5.0        22.3                46         4.0
## 349 91.7  48.5 696.1 11.1        16.8                45         4.5
## 350 91.7  48.5 696.1 11.1        16.1                44         4.0
## 351 92.5  88.0 698.6  7.1        22.8                40         4.0
## 352 92.5  88.0 698.6  7.1        17.8                51         7.2
## 353 92.5  88.0 698.6  7.1        19.6                48         2.7
## 354 92.5  88.0 698.6  7.1        20.3                45         3.1
## 355 94.8 222.4 698.6 13.9        20.3                42         2.7
## 356 94.8 222.4 698.6 13.9        27.5                27         4.9
## 357 94.8 222.4 698.6 13.9        26.2                34         5.8
## 358 94.8 222.4 698.6 13.9        23.9                38         6.7
## 359 92.9 133.3 699.6  9.2        26.4                21         4.5
## 360 92.9 133.3 699.6  9.2        21.9                35         1.8
## 361 92.9 133.3 699.6  9.2        24.3                25         4.0
## 362 92.9 133.3 699.6  9.2        19.4                19         1.3
## 363 92.9 133.3 699.6  9.2        26.4                21         4.5
## 364 91.8 175.1 700.7 13.8        22.4                54         7.6
## 365 91.8 175.1 700.7 13.8        26.8                38         6.3
## 366 91.8 175.1 700.7 13.8        25.7                39         5.4
## 367 91.8 175.1 700.7 13.8        21.9                73         7.6
## 368 89.7  90.0 704.4  4.8        17.8                64         1.3
## 369 89.7  90.0 704.4  4.8        22.8                39         3.6
## 370 89.7  90.0 704.4  4.8        17.8                67         2.2
## 371 92.9 137.0 706.4  9.2        20.8                17         1.3
## 372 92.9 137.0 706.4  9.2        27.7                24         2.2
## 373 92.9 137.0 706.4  9.2        21.5                15         0.9
## 374 92.9 137.0 706.4  9.2        25.4                27         2.2
## 375 92.9 137.0 706.4  9.2        22.4                34         2.2
## 376 92.9 137.0 706.4  9.2        21.5                15         0.9
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## 377 92.9 137.0 706.4  9.2        22.1                34         1.8
## 378 50.4  46.2 706.6  0.4        12.2                78         6.3
## 379 94.8 227.0 706.7 12.0        23.3                34         3.1
## 380 94.8 227.0 706.7 12.0        23.3                34         3.1
## 381 94.8 227.0 706.7 12.0        25.0                36         4.0
## 382 88.6  69.7 706.8  5.8        20.6                37         1.8
## 383 88.6  91.8 709.9  7.1        11.2                78         7.6
## 384 88.6  91.8 709.9  7.1        17.4                56         5.4
## 385 88.6  91.8 709.9  7.1        12.4                73         6.3
## 386 92.8  73.2 713.0 22.6        19.3                38         4.0
## 387 93.3 141.2 713.9 13.9        22.9                44         5.4
## 388 93.3 141.2 713.9 13.9        27.6                30         1.3
## 389 93.3 141.2 713.9 13.9        18.6                49         3.6
## 390 89.6  84.1 714.3  5.7        19.0                52         2.2
## 391 89.6  84.1 714.3  5.7        17.1                53         5.4
## 392 89.6  84.1 714.3  5.7        23.8                35         3.6
## 393 93.7 231.1 715.1  8.4        21.9                42         2.2
## 394 93.7 231.1 715.1  8.4        25.9                32         3.1
## 395 93.7 231.1 715.1  8.4        26.4                33         3.6
## 396 93.7 231.1 715.1  8.4        26.9                31         3.6
## 397 93.7 231.1 715.1  8.4        23.6                53         4.0
## 398 93.7 231.1 715.1  8.4        18.9                64         4.9
## 399 93.7 231.1 715.1  8.4        18.9                64         4.9
## 400 93.7 231.1 715.1  8.4        18.9                64         4.9
## 401 91.7  75.6 718.3  7.8        17.7                39         3.6
## 402 92.1  87.7 721.1  9.5        18.1                54         3.1
## 403 93.4 145.4 721.4  8.1        30.2                24         2.7
## 404 93.4 145.4 721.4  8.1        29.6                27         2.7
## 405 93.4 145.4 721.4  8.1        28.6                27         2.2
## 406 93.6 235.1 723.1 10.1        24.1                50         4.0
## 407 93.6 235.1 723.1 10.1        20.9                66         4.9
## 408 91.8  78.5 724.3  9.2        19.1                38         2.7
## 409 91.8  78.5 724.3  9.2        21.2                32         2.7
## 410 91.8  78.5 724.3  9.2        18.9                35         2.7
## 411 87.9  84.8 725.1  3.7        21.8                34         2.2
## 412 88.1  53.3 726.9  5.4        13.7                56         1.8
## 413 93.5 149.3 728.6  8.1        22.8                39         3.6
## 414 93.5 149.3 728.6  8.1        25.3                36         3.6
## 415 93.5 149.3 728.6  8.1        17.2                43         3.1
## 416 93.5 149.3 728.6  8.1        22.9                39         4.9
## 417 93.5 149.3 728.6  8.1        28.3                26         3.1
## 418 93.5 149.3 728.6  8.1        27.8                27         3.1
## 419 90.3  80.7 730.2  6.3        18.2                62         4.5
## 420 90.3  80.7 730.2  6.3        17.8                63         4.9
## 421 91.5 238.2 730.6  7.5        17.7                65         4.0
## 422 91.1  88.2 731.7  8.3        22.8                46         4.0
## 423 88.2  55.2 732.3 11.6        15.2                64         3.1
## 424 90.1  82.9 735.7  6.2        12.9                74         4.9
## 425 90.1  82.9 735.7  6.2        18.3                45         2.2
## 426 90.1  82.9 735.7  6.2        15.4                57         4.5
## 427 91.1  91.3 738.1  7.2        20.7                46         2.7
## 428 91.1  91.3 738.1  7.2        19.1                46         2.2
## 429 92.4  96.2 739.4  8.6        18.6                24         5.8
## 430 92.4  96.2 739.4  8.6        19.2                24         4.9
```

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## 431 91.2  94.3 744.4  8.4        16.8                47         4.9
## 432 91.2  94.3 744.4  8.4        15.4                57         4.9
## 433 91.2  94.3 744.4  8.4        22.3                48         4.0
## 434 91.0 163.2 744.4 10.1        26.7                35         1.8
## 435 92.1  99.0 745.3  9.6        10.1                75         3.6
## 436 92.1  99.0 745.3  9.6        17.4                57         4.5
## 437 92.1  99.0 745.3  9.6        12.8                64         3.6
## 438 92.1  99.0 745.3  9.6        10.1                75         3.6
## 439 92.1  99.0 745.3  9.6        15.4                53         6.3
## 440 92.1  99.0 745.3  9.6        20.6                43         3.6
## 441 92.1  99.0 745.3  9.6        19.8                47         2.7
## 442 92.1  99.0 745.3  9.6        18.7                50         2.2
## 443 92.1  99.0 745.3  9.6        20.8                35         4.9
## 444 92.1  99.0 745.3  9.6        20.8                35         4.9
## 445 90.5  96.7 750.5 11.4        20.6                55         5.4
## 446 90.5  96.7 750.5 11.4        20.4                55         4.9
## 447 92.2 102.3 751.5  8.4        24.2                27         3.1
## 448 92.2 102.3 751.5  8.4        24.1                27         3.1
## 449 92.2 102.3 751.5  8.4        21.2                32         2.2
## 450 92.2 102.3 751.5  8.4        19.7                35         1.8
## 451 92.2 102.3 751.5  8.4        23.5                27         4.0
## 452 92.2 102.3 751.5  8.4        24.2                27         3.1
## 453 91.0 166.9 752.6  7.1        18.5                73         8.5
## 454 91.0 166.9 752.6  7.1        25.9                41         3.6
## 455 91.0 166.9 752.6  7.1        25.9                41         3.6
## 456 91.0 166.9 752.6  7.1        18.2                62         5.4
## 457 91.0 166.9 752.6  7.1        21.1                71         7.6
## 458 91.6 248.4 753.8  6.3        20.5                58         2.7
## 459 91.6 248.4 753.8  6.3        20.4                56         2.2
## 460 91.6 248.4 753.8  6.3        20.4                56         2.2
## 461 91.6 248.4 753.8  6.3        16.8                56         3.1
## 462 91.6 248.4 753.8  6.3        16.6                59         2.7
## 463 92.4 105.8 758.1  9.9        16.0                45         1.8
## 464 92.4 105.8 758.1  9.9        24.9                27         2.2
## 465 92.4 105.8 758.1  9.9        25.3                27         2.7
## 466 92.4 105.8 758.1  9.9        24.8                28         1.8
## 467 91.6 108.4 764.0  6.2        18.0                51         5.4
## 468 91.6 108.4 764.0  6.2         9.8                86         1.8
## 469 91.6 108.4 764.0  6.2        19.3                44         2.2
## 470 91.6 108.4 764.0  6.2        23.0                34         2.2
## 471 91.6 108.4 764.0  6.2        22.7                35         2.2
## 472 91.6 108.4 764.0  6.2        20.4                41         1.8
## 473 91.6 108.4 764.0  6.2        19.3                44         2.2
## 474 89.4 253.6 768.4  9.7        14.2                73         2.7
## 475 91.9 111.7 770.3  6.5        15.7                51         2.2
## 476 91.9 111.7 770.3  6.5        15.9                53         2.2
## 477 91.9 111.7 770.3  6.5        21.1                35         2.7
## 478 91.9 111.7 770.3  6.5        19.6                45         3.1
## 479 92.6 115.4 777.1  8.8        24.3                27         4.9
## 480 92.6 115.4 777.1  8.8        19.7                41         1.8
## 481 92.8 119.0 783.5  7.5        21.6                27         2.2
## 482 92.8 119.0 783.5  7.5        21.6                28         6.3
## 483 92.8 119.0 783.5  7.5        18.9                34         7.2
## 484 92.8 119.0 783.5  7.5        16.8                28         4.0
```

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## 485 92.8 119.0 783.5  7.5        16.8                28         4.0
## 486 92.5 122.0 789.7 10.2        15.9                55         3.6
## 487 92.5 122.0 789.7 10.2        19.7                39         2.7
## 488 92.5 122.0 789.7 10.2        21.1                39         2.2
## 489 92.5 122.0 789.7 10.2        18.4                42         2.2
## 490 92.5 122.0 789.7 10.2        17.3                45         4.0
## 491 91.2 124.4 795.3  8.5        21.5                28         4.5
## 492 91.2 124.4 795.3  8.5        17.1                41         2.2
## 493 88.9 263.1 795.9  5.2        29.3                27         3.6
## 494 89.4 266.2 803.3  5.6        17.4                54         3.1
## 495 91.5 130.1 807.1  7.5        20.6                37         1.8
## 496 91.5 130.1 807.1  7.5        15.9                51         4.5
## 497 91.5 130.1 807.1  7.5        12.2                66         4.9
## 498 91.5 130.1 807.1  7.5        16.8                43         3.1
## 499 91.5 130.1 807.1  7.5        21.3                35         2.2
## 500 90.6 269.8 811.2  5.5        22.2                45         3.6
## 501 91.1 132.3 812.1 12.5        15.9                38         5.4
## 502 91.1 132.3 812.1 12.5        16.4                27         3.6
## 503 91.2 134.7 817.5  7.2        18.5                30         2.7
## 504 91.6 273.8 819.1  7.7        21.3                44         4.5
## 505 91.6 273.8 819.1  7.7        15.5                72         8.0
## 506 90.7 136.9 822.8  6.8        12.9                39         2.7
## 507 91.0 276.3 825.1  7.1        13.8                77         7.6
## 508 91.0 276.3 825.1  7.1        13.8                77         7.6
## 509 91.0 276.3 825.1  7.1        21.9                43         4.0
## 510 91.0 276.3 825.1  7.1        14.5                76         7.6
## 511 89.7 284.9 844.0 10.1        10.5                77         4.0
## 512 89.7 287.2 849.3  6.8        19.4                45         3.6
## 513 90.3 290.0 855.3  7.4        10.3                78         4.0
## 514 90.3 290.0 855.3  7.4        19.9                44         3.1
## 515 90.3 290.0 855.3  7.4        16.2                58         3.6
## 516 90.3 290.0 855.3  7.4        16.2                58         3.6
## 517 87.1 291.3 860.6  4.0        17.0                67         4.9
##     rain amount fire__no_yes
## 1           0.0            0
## 2           0.0            0
## 3           0.0            1
## 4           0.0            0
## 5           0.0            1
## 6           0.0            1
## 7           0.0            1
## 8           0.0            1
## 9           0.0            0
## 10          0.0            1
## 11          0.0            0
## 12          0.0            0
## 13          0.0            0
## 14          0.0            0
## 15          0.0            0
## 16          0.0            0
## 17          0.0            0
## 18          0.0            1
## 19          0.0            0
## 20          0.0            1
```

```
## 21          0.0             1
## 22          0.0             1
## 23          0.0             0
## 24          0.0             0
## 25          0.0             0
## 26          0.0             1
## 27          0.0             1
## 28          0.0             0
## 29          0.0             1
## 30          0.0             0
## 31          0.0             1
## 32          0.0             0
## 33          0.0             1
## 34          0.0             1
## 35          0.0             1
## 36          0.0             0
## 37          0.0             0
## 38          0.0             1
## 39          0.0             0
## 40          0.0             0
## 41          0.0             0
## 42          0.0             0
## 43          0.0             0
## 44          0.0             0
## 45          0.0             0
## 46          0.0             1
## 47          0.0             0
## 48          0.0             0
## 49          0.0             0
## 50          0.0             0
## 51          0.2             0
## 52          0.0             0
## 53          0.0             0
## 54          0.0             0
## 55          0.0             0
## 56          0.0             0
## 57          0.0             1
## 58          0.0             1
## 59          0.0             1
## 60          0.0             0
## 61          0.0             0
## 62          0.0             1
## 63          0.0             1
## 64          0.0             1
## 65          0.0             0
## 66          0.0             1
## 67          0.0             1
## 68          0.0             0
## 69          0.0             0
## 70          0.0             0
## 71          0.0             1
## 72          0.0             1
## 73          0.0             1
## 74          0.0             1
```

```
## 75          0.0             0
## 76          0.0             0
## 77          0.0             0
## 78          0.0             0
## 79          0.0             0
## 80          0.0             1
## 81          0.0             0
## 82          0.0             0
## 83          0.0             0
## 84          0.0             1
## 85          0.0             1
## 86          0.0             0
## 87          0.0             0
## 88          0.0             0
## 89          0.0             0
## 90          0.0             1
## 91          0.0             0
## 92          0.0             0
## 93          0.0             0
## 94          0.0             1
## 95          0.0             1
## 96          0.0             0
## 97          0.0             1
## 98          0.0             0
## 99          0.0             1
## 100         0.0             0
## 101         0.0             1
## 102         0.0             1
## 103         0.0             1
## 104         0.0             1
## 105         0.0             1
## 106         0.0             1
## 107         0.0             1
## 108         0.0             1
## 109         0.0             1
## 110         0.0             1
## 111         0.0             1
## 112         0.0             1
## 113         0.0             1
## 114         0.0             0
## 115         0.0             1
## 116         0.0             1
## 117         0.0             0
## 118         0.0             0
## 119         0.0             0
## 120         0.0             0
## 121         0.0             1
## 122         0.0             0
## 123         0.0             1
## 124         0.0             1
## 125         0.0             1
## 126         0.0             1
## 127         0.0             0
## 128         0.0             1
```

```
## 129          0.0             1
## 130          0.2             0
## 131          0.0             1
## 132          0.0             1
## 133          0.0             0
## 134          0.0             0
## 135          0.0             1
## 136          0.0             1
## 137          0.0             0
## 138          0.0             0
## 139          0.0             0
## 140          0.0             0
## 141          0.0             0
## 142          0.0             0
## 143          0.0             1
## 144          0.0             1
## 145          0.0             1
## 146          0.0             0
## 147          0.0             0
## 148          0.0             0
## 149          0.0             1
## 150          0.0             1
## 151          0.0             1
## 152          0.0             0
## 153          0.0             0
## 154          0.0             1
## 155          0.0             0
## 156          0.0             1
## 157          0.0             1
## 158          0.0             1
## 159          0.0             0
## 160          0.0             0
## 161          0.0             1
## 162          0.0             0
## 163          0.0             1
## 164          0.0             1
## 165          0.0             1
## 166          0.0             1
## 167          0.0             1
## 168          0.0             1
## 169          0.0             1
## 170          0.0             1
## 171          0.0             1
## 172          0.0             1
## 173          0.0             1
## 174          0.0             1
## 175          0.0             1
## 176          0.0             0
## 177          0.0             1
## 178          0.0             1
## 179          0.0             0
## 180          0.0             0
## 181          0.0             1
## 182          0.0             1
```

```
## 183         0.0             1
## 184         0.0             0
## 185         0.0             0
## 186         0.0             0
## 187         0.0             0
## 188         0.0             0
## 189         0.0             0
## 190         0.0             1
## 191         0.0             1
## 192         0.0             1
## 193         0.0             1
## 194         0.0             1
## 195         0.0             1
## 196         0.0             0
## 197         0.0             0
## 198         0.0             1
## 199         0.0             0
## 200         0.0             0
## 201         0.0             0
## 202         0.0             1
## 203         0.0             1
## 204         0.0             1
## 205         0.0             1
## 206         0.0             1
## 207         0.0             0
## 208         0.0             0
## 209         0.0             0
## 210         0.0             1
## 211         0.0             0
## 212         0.0             1
## 213         0.0             0
## 214         0.0             0
## 215         0.0             0
## 216         0.0             1
## 217         0.0             1
## 218         0.0             1
## 219         0.0             0
## 220         0.0             0
## 221         0.0             0
## 222         0.0             0
## 223         0.0             1
## 224         0.0             1
## 225         0.0             0
## 226         0.0             1
## 227         0.0             1
## 228         0.0             1
## 229         0.0             0
## 230         0.0             0
## 231         0.0             1
## 232         0.0             0
## 233         0.0             1
## 234         0.0             0
## 235         0.0             0
## 236         0.0             0
```

```
## 237         0.0             1
## 238         0.0             1
## 239         0.0             1
## 240         0.0             1
## 241         0.0             1
## 242         0.0             0
## 243         0.0             0
## 244         0.0             0
## 245         0.0             1
## 246         0.0             1
## 247         0.0             1
## 248         0.0             0
## 249         0.0             0
## 250         0.0             1
## 251         0.0             1
## 252         0.0             1
## 253         0.0             1
## 254         0.0             0
## 255         0.0             0
## 256         0.0             0
## 257         0.0             0
## 258         0.0             1
## 259         0.0             0
## 260         0.0             1
## 261         0.0             0
## 262         0.0             1
## 263         0.0             0
## 264         0.0             0
## 265         0.0             1
## 266         0.0             0
## 267         0.0             1
## 268         0.0             1
## 269         0.0             1
## 270         0.0             0
## 271         0.0             1
## 272         0.0             1
## 273         0.0             1
## 274         0.0             1
## 275         0.0             0
## 276         0.0             0
## 277         0.0             0
## 278         0.0             0
## 279         0.0             1
## 280         0.0             1
## 281         0.0             0
## 282         0.0             0
## 283         0.0             1
## 284         0.0             1
## 285         0.4             0
## 286         0.8             0
## 287         0.8             0
## 288         6.4             1
## 289         0.0             0
## 290         0.0             1
```

```
## 291         0.0             1
## 292         0.0             0
## 293         0.0             1
## 294         0.0             1
## 295         0.0             1
## 296         0.0             0
## 297         0.0             1
## 298         0.0             0
## 299         0.0             1
## 300         0.0             1
## 301         0.0             1
## 302         0.0             1
## 303         0.0             0
## 304         0.0             0
## 305         0.0             1
## 306         0.0             1
## 307         0.0             0
## 308         0.0             0
## 309         0.0             1
## 310         0.0             0
## 311         0.0             1
## 312         0.0             1
## 313         0.0             0
## 314         0.0             0
## 315         0.0             0
## 316         0.0             0
## 317         0.0             1
## 318         0.0             1
## 319         0.0             1
## 320         0.0             0
## 321         0.0             0
## 322         0.0             1
## 323         0.0             1
## 324         0.0             1
## 325         0.0             1
## 326         0.0             0
## 327         0.0             1
## 328         0.0             0
## 329         0.0             0
## 330         0.0             0
## 331         0.0             0
## 332         0.0             0
## 333         0.0             0
## 334         0.0             0
## 335         0.0             1
## 336         0.0             1
## 337         0.0             0
## 338         0.0             1
## 339         0.0             0
## 340         0.0             0
## 341         0.0             1
## 342         0.0             1
## 343         0.0             1
## 344         0.0             1
```

```
## 345          0.0             1
## 346          0.0             1
## 347          0.0             1
## 348          0.0             0
## 349          0.0             1
## 350          0.0             1
## 351          0.0             0
## 352          0.0             0
## 353          0.0             0
## 354          0.0             0
## 355          0.0             0
## 356          0.0             1
## 357          0.0             0
## 358          0.0             0
## 359          0.0             0
## 360          0.0             1
## 361          0.0             1
## 362          0.0             1
## 363          0.0             1
## 364          0.0             1
## 365          0.0             1
## 366          0.0             1
## 367          1.0             0
## 368          0.0             0
## 369          0.0             0
## 370          0.0             1
## 371          0.0             0
## 372          0.0             0
## 373          0.0             0
## 374          0.0             0
## 375          0.0             0
## 376          0.0             1
## 377          0.0             1
## 378          0.0             0
## 379          0.0             1
## 380          0.0             0
## 381          0.0             0
## 382          0.0             0
## 383          0.0             0
## 384          0.0             0
## 385          0.0             1
## 386          0.0             0
## 387          0.0             0
## 388          0.0             0
## 389          0.0             1
## 390          0.0             0
## 391          0.0             1
## 392          0.0             1
## 393          0.0             1
## 394          0.0             0
## 395          0.0             0
## 396          0.0             1
## 397          0.0             1
## 398          0.0             1
```

```
## 399          0.0             0
## 400          0.0             0
## 401          0.0             0
## 402          0.0             1
## 403          0.0             0
## 404          0.0             1
## 405          0.0             1
## 406          0.0             0
## 407          0.0             1
## 408          0.0             0
## 409          0.0             0
## 410          0.0             0
## 411          0.0             1
## 412          0.0             1
## 413          0.0             0
## 414          0.0             0
## 415          0.0             0
## 416          0.0             1
## 417          0.0             1
## 418          0.0             1
## 419          0.0             0
## 420          0.0             0
## 421          0.0             0
## 422          0.0             1
## 423          0.0             1
## 424          0.0             0
## 425          0.0             1
## 426          0.0             1
## 427          0.0             1
## 428          0.0             1
## 429          0.0             0
## 430          0.0             1
## 431          0.0             1
## 432          0.0             1
## 433          0.0             1
## 434          0.0             1
## 435          0.0             0
## 436          0.0             0
## 437          0.0             1
## 438          0.0             1
## 439          0.0             1
## 440          0.0             1
## 441          0.0             1
## 442          0.0             1
## 443          0.0             1
## 444          0.0             1
## 445          0.0             1
## 446          0.0             1
## 447          0.0             0
## 448          0.0             0
## 449          0.0             0
## 450          0.0             0
## 451          0.0             1
## 452          0.0             1
```

```
## 453         0.0             0
## 454         0.0             0
## 455         0.0             0
## 456         0.0             1
## 457         1.4             1
## 458         0.0             1
## 459         0.0             0
## 460         0.0             0
## 461         0.0             0
## 462         0.0             0
## 463         0.0             0
## 464         0.0             0
## 465         0.0             0
## 466         0.0             1
## 467         0.0             0
## 468         0.0             0
## 469         0.0             0
## 470         0.0             1
## 471         0.0             1
## 472         0.0             1
## 473         0.0             1
## 474         0.0             0
## 475         0.0             0
## 476         0.0             1
## 477         0.0             1
## 478         0.0             1
## 479         0.0             0
## 480         0.0             1
## 481         0.0             0
## 482         0.0             1
## 483         0.0             1
## 484         0.0             1
## 485         0.0             1
## 486         0.0             0
## 487         0.0             0
## 488         0.0             1
## 489         0.0             1
## 490         0.0             1
## 491         0.0             1
## 492         0.0             1
## 493         0.0             1
## 494         0.0             0
## 495         0.0             0
## 496         0.0             1
## 497         0.0             1
## 498         0.0             1
## 499         0.0             1
## 500         0.0             0
## 501         0.0             1
## 502         0.0             0
## 503         0.0             0
## 504         0.0             1
## 505         0.0             1
## 506         0.0             1
```

```
## 507         0.0             0
## 508         0.0             1
## 509         0.0             1
## 510         0.0             1
## 511         0.0             0
## 512         0.0             0
## 513         0.0             1
## 514         0.0             1
## 515         0.0             0
## 516         0.0             1
## 517         0.0             1
```

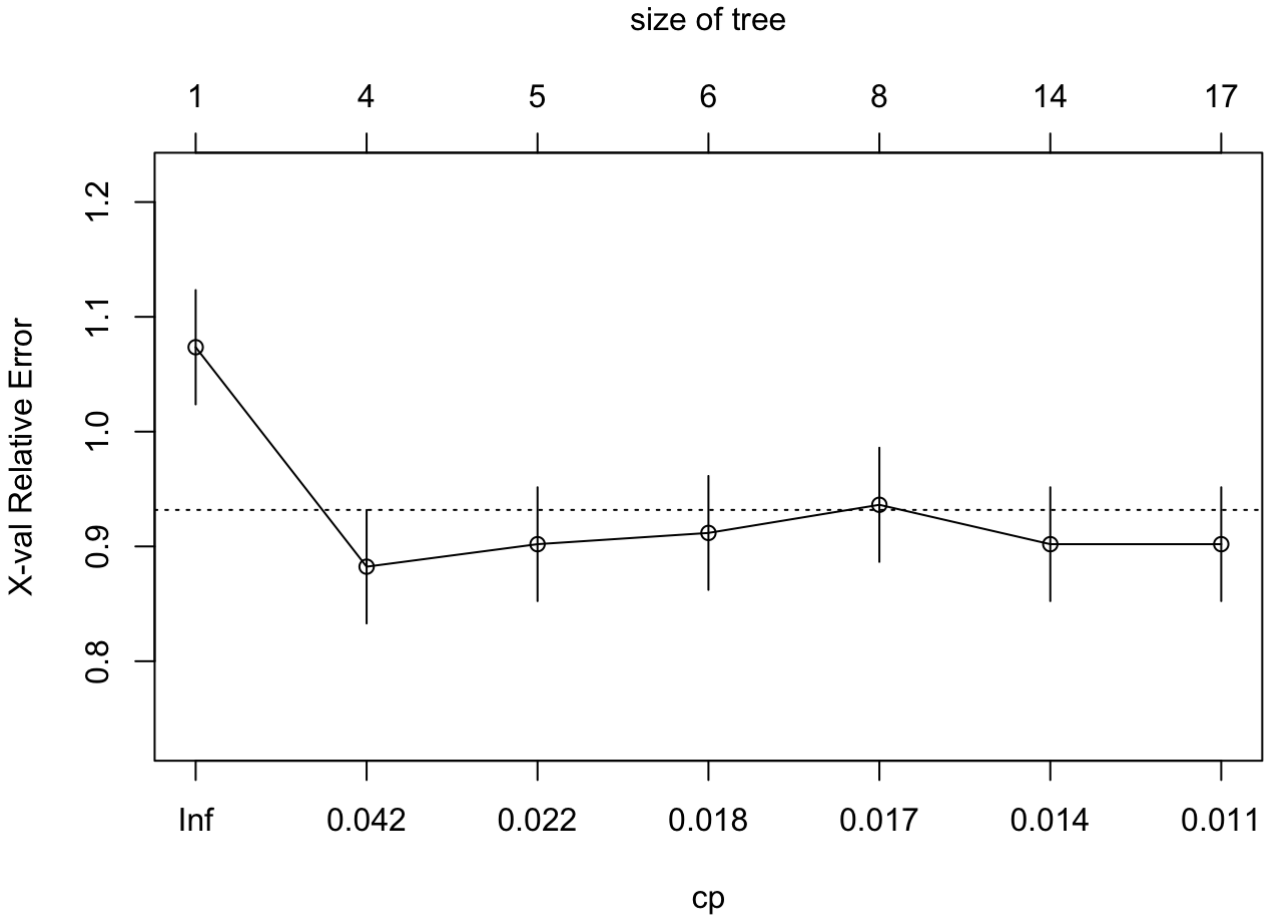
```
set.seed(123)
index1 <- sample(1:nrow(ff3), round(nrow(ff3)*.8))
ff4 <- ff3[index1,]
dt <- rpart(ff4$fire__no_yes ~., method = 'class', data = ff4)
dt
```

```
## n= 414
##
## node), split, n, loss, yval, (yprob)
##       * denotes terminal node
##
##    1) root 414 204 1 (0.49275362 0.50724638)
##      2) temperature>=5.15 400 197 0 (0.50750000 0.49250000)
##        4) DC< 731.15 331 151 0 (0.54380665 0.45619335)
##          8) temperature< 21.65 220  85 0 (0.61363636 0.38636364)
##           16) ISI< 2.45 7   0 0 (1.00000000 0.00000000) *
##           17) ISI>=2.45 213  85 0 (0.60093897 0.39906103)
##             34) DMC>=141.85 37  10 0 (0.72972973 0.27027027) *
##             35) DMC< 141.85 176  75 0 (0.57386364 0.42613636)
##               70) DMC< 115.75 140  52 0 (0.62857143 0.37142857)
##                140) temperature>=13.75 96  29 0 (0.69791667 0.30208333)
##                  280) DC< 79.15 13   0 0 (1.00000000 0.00000000) *
##                  281) DC>=79.15 83  29 0 (0.65060241 0.34939759)
##                    562) temperature>=17.2 56  15 0 (0.73214286 0.26785714) *
##                    563) temperature< 17.2 27  13 1 (0.48148148 0.51851852)
##                     1126) temperature< 16 14   4 0 (0.71428571 0.28571429) *
##                     1127) temperature>=16 13   3 1 (0.23076923 0.76923077) *
##                141) temperature< 13.75 44  21 1 (0.47727273 0.52272727)
##                  282) temperature< 12.35 36  16 0 (0.55555556 0.44444444)
##                    564) ISI>=3.9 27   9 0 (0.66666667 0.33333333) *
##                    565) ISI< 3.9 9   2 1 (0.22222222 0.77777778) *
##                  283) temperature>=12.35 8   1 1 (0.12500000 0.87500000) *
##               71) DMC>=115.75 36  13 1 (0.36111111 0.63888889) *
##          9) temperature>=21.65 111  45 1 (0.40540541 0.59459459)
##           18) DMC>=209.55 11   3 0 (0.72727273 0.27272727) *
##           19) DMC< 209.55 100  37 1 (0.37000000 0.63000000)
##             38) relative humidity< 24.5 12   4 0 (0.66666667 0.33333333) *
##             39) relative humidity>=24.5 88  29 1 (0.32954545 0.67045455) *
##        5) DC>=731.15 69  23 1 (0.33333333 0.66666667)
##         10) DMC>=100.65 49  21 1 (0.42857143 0.57142857)
##           20) DC< 769.35 21   7 0 (0.66666667 0.33333333) *
##           21) DC>=769.35 28   7 1 (0.25000000 0.75000000) *
##         11) DMC< 100.65 20   2 1 (0.10000000 0.90000000) *
##      3) temperature< 5.15 14   1 1 (0.07142857 0.92857143) *
```

```
printcp(dt) # display the results
```

```
##
## Classification tree:
## rpart(formula = ff4$fire__no_yes ~ ., data = ff4, method = "class")
##
## Variables actually used in tree construction:
## [1] DC                DMC               ISI               relative humidity
## [5] temperature
##
## Root node error: 204/414 = 0.49275
##
## n= 414
##
##         CP nsplit rel error  xerror     xstd
## 1 0.071078      0   1.00000 1.07353 0.049786
## 2 0.024510      3   0.75490 0.88235 0.049444
## 3 0.019608      4   0.73039 0.90196 0.049561
## 4 0.017157      5   0.71078 0.91176 0.049613
## 5 0.016340      7   0.67647 0.93627 0.049721
## 6 0.011438     13   0.57353 0.90196 0.049561
## 7 0.010000     16   0.53922 0.90196 0.049561
```

```
plotcp(dt) # visualize cross-validation results
```




```
summary(dt)
```

```
## Call:
## rpart(formula = ff4$fire__no_yes ~ ., data = ff4, method = "class")
##   n= 414
##
##           CP nsplit rel error    xerror       xstd
## 1 0.07107843      0 1.0000000 1.0735294 0.04978621
## 2 0.02450980      3 0.7549020 0.8823529 0.04944403
## 3 0.01960784      4 0.7303922 0.9019608 0.04956128
## 4 0.01715686      5 0.7107843 0.9117647 0.04961278
## 5 0.01633987      7 0.6764706 0.9362745 0.04972088
## 6 0.01143791     13 0.5735294 0.9019608 0.04956128
## 7 0.01000000     16 0.5392157 0.9019608 0.04956128
##
## Variable importance
##       temperature               DMC                DC              FFMC
##                27                24                20                11
##               ISI relative humidity       wind speeds
##                10                 6                 1
##
## Node number 1: 414 observations,    complexity param=0.07107843
##   predicted class=1  expected loss=0.4927536  P(node) =1
##     class counts:   204   210
##    probabilities: 0.493 0.507
##   left son=2 (400 obs) right son=3 (14 obs)
##   Primary splits:
##       temperature       < 5.15   to the right, improve=5.144379, (0 missing)
##       DC                < 731.15 to the left,  improve=4.208696, (0 missing)
##       wind speeds       < 8.25   to the left,  improve=4.143089, (0 missing)
##       relative humidity < 85     to the right, improve=2.393472, (0 missing)
##       ISI               < 1.65   to the left,  improve=2.383862, (0 missing)
##
## Node number 2: 400 observations,    complexity param=0.07107843
##   predicted class=0  expected loss=0.4925  P(node) =0.9661836
##     class counts:   203   197
##    probabilities: 0.508 0.493
##   left son=4 (331 obs) right son=5 (69 obs)
##   Primary splits:
##       DC                < 731.15 to the left,  improve=5.058726, (0 missing)
##       DMC               < 48.1   to the left,  improve=4.455574, (0 missing)
##       temperature       < 21.75  to the left,  improve=3.371667, (0 missing)
##       relative humidity < 85     to the right, improve=3.160128, (0 missing)
##       FFMC              < 80.5   to the left,  improve=2.205000, (0 missing)
##   Surrogate splits:
##       DMC < 243.3  to the left,  agree=0.865, adj=0.217, (0 split)
##
## Node number 3: 14 observations
##   predicted class=1  expected loss=0.07142857  P(node) =0.03381643
##     class counts:     1    13
##    probabilities: 0.071 0.929
##
## Node number 4: 331 observations,    complexity param=0.07107843
##   predicted class=0  expected loss=0.4561934  P(node) =0.7995169
##     class counts:   180   151
```

```
##    probabilities: 0.544 0.456
##   left son=8 (220 obs) right son=9 (111 obs)
##   Primary splits:
##       temperature       < 21.65  to the left,  improve=6.397912, (0 missing)
##       DMC               < 99.75  to the left,  improve=4.397195, (0 missing)
##       relative humidity < 71.5   to the right, improve=3.179390, (0 missing)
##       FFMC              < 80.5   to the left,  improve=1.798493, (0 missing)
##       ISI               < 1.7    to the left,  improve=1.798493, (0 missing)
##   Surrogate splits:
##       FFMC              < 92.65  to the left,  agree=0.755, adj=0.270, (0 split)
##       relative humidity < 36.5   to the right, agree=0.728, adj=0.189, (0 split)
##       DMC               < 148.55 to the left,  agree=0.719, adj=0.162, (0 split)
##       ISI               < 12.95  to the left,  agree=0.707, adj=0.126, (0 split)
##       DC                < 699.1  to the left,  agree=0.674, adj=0.027, (0 split)
##
## Node number 5: 69 observations,    complexity param=0.01715686
##   predicted class=1  expected loss=0.3333333  P(node) =0.1666667
##     class counts:    23    46
##    probabilities: 0.333 0.667
##   left son=10 (49 obs) right son=11 (20 obs)
##   Primary splits:
##       DMC               < 100.65 to the right, improve=3.066667, (0 missing)
##       DC                < 751    to the right, improve=3.066667, (0 missing)
##       wind speeds       < 3.35   to the left,  improve=2.904040, (0 missing)
##       relative humidity < 27.5   to the left,  improve=2.300000, (0 missing)
##       FFMC              < 92.15  to the right, improve=1.734540, (0 missing)
##   Surrogate splits:
##       DC                < 751    to the right, agree=1.000, adj=1.00, (0 split)
##       ISI               < 8.55   to the left,  agree=0.754, adj=0.15, (0 split)
##       relative humidity < 25.5   to the right, agree=0.739, adj=0.10, (0 split)
##
## Node number 8: 220 observations,    complexity param=0.01633987
##   predicted class=0  expected loss=0.3863636  P(node) =0.531401
##     class counts:   135    85
##    probabilities: 0.614 0.386
##   left son=16 (7 obs) right son=17 (213 obs)
##   Primary splits:
##       ISI               < 2.45   to the left,  improve=2.158557, (0 missing)
##       DMC               < 100.45 to the left,  improve=1.658607, (0 missing)
##       wind speeds       < 7.8    to the left,  improve=1.554936, (0 missing)
##       relative humidity < 73.5   to the right, improve=1.528182, (0 missing)
##       FFMC              < 84.5   to the left,  improve=1.493953, (0 missing)
##   Surrogate splits:
##       FFMC < 80.5   to the left,  agree=0.995, adj=0.857, (0 split)
##       DMC  < 3.1    to the left,  agree=0.982, adj=0.429, (0 split)
##
## Node number 9: 111 observations,    complexity param=0.0245098
##   predicted class=1  expected loss=0.4054054  P(node) =0.2681159
##     class counts:    45    66
##    probabilities: 0.405 0.595
##   left son=18 (11 obs) right son=19 (100 obs)
##   Primary splits:
##       DMC               < 209.55 to the right, improve=2.529877, (0 missing)
##       DC                < 689.55 to the right, improve=2.504862, (0 missing)
```

```
##       relative humidity < 24.5   to the left,  improve=2.424032, (0 missing)
##       FFMC              < 92.2   to the right, improve=1.653374, (0 missing)
##       temperature       < 22.15  to the right, improve=1.220786, (0 missing)
##
## Node number 10: 49 observations,    complexity param=0.01715686
##   predicted class=1  expected loss=0.4285714  P(node) =0.1183575
##     class counts:    21    28
##    probabilities: 0.429 0.571
##   left son=20 (21 obs) right son=21 (28 obs)
##   Primary splits:
##       DC                < 769.35 to the left,  improve=4.166667, (0 missing)
##       wind speeds       < 3.8    to the left,  improve=3.200000, (0 missing)
##       DMC               < 107.1  to the left,  improve=1.975610, (0 missing)
##       relative humidity < 27.5   to the left,  improve=1.333333, (0 missing)
##       ISI               < 8.05   to the right, improve=0.800000, (0 missing)
##   Surrogate splits:
##       DMC         < 110.05 to the left,  agree=0.837, adj=0.619, (0 split)
##       ISI         < 6.4    to the left,  agree=0.714, adj=0.333, (0 split)
##       temperature < 22.15  to the right, agree=0.714, adj=0.333, (0 split)
##       FFMC        < 91.55  to the right, agree=0.673, adj=0.238, (0 split)
##       wind speeds < 2.45   to the left,  agree=0.673, adj=0.238, (0 split)
##
## Node number 11: 20 observations
##   predicted class=1  expected loss=0.1  P(node) =0.04830918
##     class counts:     2    18
##    probabilities: 0.100 0.900
##
## Node number 16: 7 observations
##   predicted class=0  expected loss=0  P(node) =0.01690821
##     class counts:     7     0
##    probabilities: 1.000 0.000
##
## Node number 17: 213 observations,    complexity param=0.01633987
##   predicted class=0  expected loss=0.399061  P(node) =0.5144928
##     class counts:   128    85
##    probabilities: 0.601 0.399
##   left son=34 (37 obs) right son=35 (176 obs)
##   Primary splits:
##       DMC               < 141.85 to the right, improve=1.4854840, (0 missing)
##       wind speeds       < 7.8    to the left,  improve=1.4384040, (0 missing)
##       DC                < 57.1   to the right, improve=1.1001010, (0 missing)
##       relative humidity < 38.5   to the left,  improve=1.0793280, (0 missing)
##       temperature       < 13.75  to the right, improve=0.9185828, (0 missing)
##   Surrogate splits:
##       FFMC              < 95.65  to the right, agree=0.840, adj=0.081, (0 split)
##       rain amount       < 0.1    to the right, agree=0.840, adj=0.081, (0 split)
##       DC                < 727.75 to the right, agree=0.831, adj=0.027, (0 split)
##       relative humidity < 85     to the right, agree=0.831, adj=0.027, (0 split)
##
## Node number 18: 11 observations
##   predicted class=0  expected loss=0.2727273  P(node) =0.02657005
##     class counts:     8     3
##    probabilities: 0.727 0.273
##
```

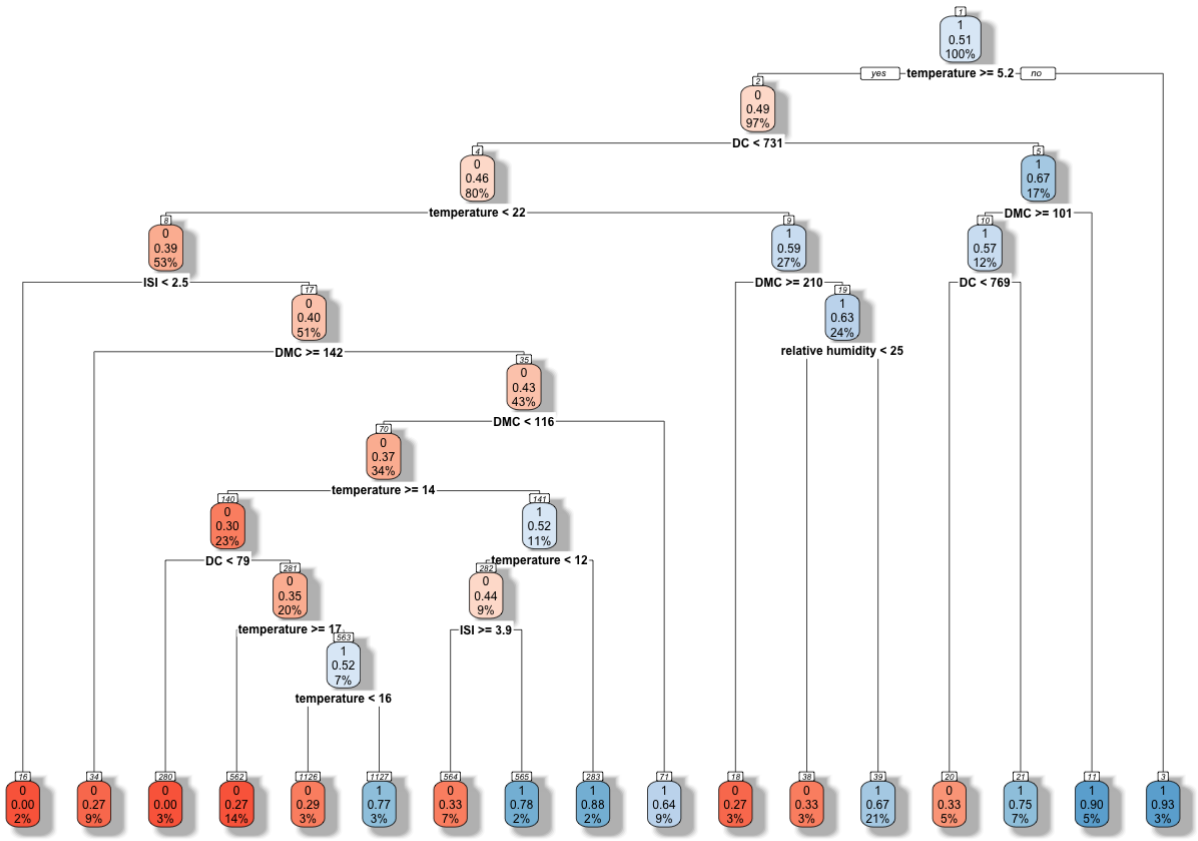
```
## Node number 19: 100 observations,    complexity param=0.01960784
##   predicted class=1  expected loss=0.37  P(node) =0.2415459
##     class counts:    37    63
##    probabilities: 0.370 0.630
##   left son=38 (12 obs) right son=39 (88 obs)
##   Primary splits:
##       relative humidity < 24.5   to the left,  improve=2.4003030, (0 missing)
##       DC                < 702.55 to the right, improve=1.4116670, (0 missing)
##       FFMC              < 94.45  to the left,  improve=1.1491380, (0 missing)
##       DMC               < 152.3  to the left,  improve=1.1266670, (0 missing)
##       ISI               < 16.9   to the left,  improve=0.8753626, (0 missing)
##
## Node number 20: 21 observations
##   predicted class=0  expected loss=0.3333333  P(node) =0.05072464
##     class counts:    14     7
##    probabilities: 0.667 0.333
##
## Node number 21: 28 observations
##   predicted class=1  expected loss=0.25  P(node) =0.06763285
##     class counts:     7    21
##    probabilities: 0.250 0.750
##
## Node number 34: 37 observations
##   predicted class=0  expected loss=0.2702703  P(node) =0.08937198
##     class counts:    27    10
##    probabilities: 0.730 0.270
##
## Node number 35: 176 observations,    complexity param=0.01633987
##   predicted class=0  expected loss=0.4261364  P(node) =0.4251208
##     class counts:   101    75
##    probabilities: 0.574 0.426
##   left son=70 (140 obs) right son=71 (36 obs)
##   Primary splits:
##       DMC               < 115.75 to the left,  improve=4.097006, (0 missing)
##       relative humidity < 38.5   to the left,  improve=1.800974, (0 missing)
##       FFMC              < 94.1   to the left,  improve=1.392045, (0 missing)
##       wind speeds       < 4.25   to the right, improve=1.263742, (0 missing)
##       ISI               < 10.15  to the left,  improve=1.226347, (0 missing)
##   Surrogate splits:
##       FFMC              < 94.95  to the left,  agree=0.818, adj=0.111, (0 split)
##       relative humidity < 21.5   to the right, agree=0.818, adj=0.111, (0 split)
##       temperature       < 21.45  to the left,  agree=0.812, adj=0.083, (0 split)
##       ISI               < 17.35  to the left,  agree=0.801, adj=0.028, (0 split)
##
## Node number 38: 12 observations
##   predicted class=0  expected loss=0.3333333  P(node) =0.02898551
##     class counts:     8     4
##    probabilities: 0.667 0.333
##
## Node number 39: 88 observations
##   predicted class=1  expected loss=0.3295455  P(node) =0.2125604
##     class counts:    29    59
##    probabilities: 0.330 0.670
##
```

```
## Node number 70: 140 observations,    complexity param=0.01633987
##   predicted class=0  expected loss=0.3714286  P(node) =0.3381643
##     class counts:    88    52
##    probabilities: 0.629 0.371
##   left son=140 (96 obs) right son=141 (44 obs)
##   Primary splits:
##       temperature       < 13.75  to the right, improve=2.937716, (0 missing)
##       relative humidity < 52.5   to the left,  improve=2.369292, (0 missing)
##       wind speeds       < 7.8    to the left,  improve=1.732331, (0 missing)
##       DC                < 57.1   to the right, improve=1.678900, (0 missing)
##       FFMC              < 92.25  to the right, improve=1.540969, (0 missing)
##   Surrogate splits:
##       FFMC              < 87.95  to the right, agree=0.800, adj=0.364, (0 split)
##       DC                < 156.9  to the right, agree=0.793, adj=0.341, (0 split)
##       DMC               < 25.3   to the right, agree=0.779, adj=0.295, (0 split)
##       ISI               < 5.6    to the right, agree=0.736, adj=0.159, (0 split)
##       relative humidity < 68.5   to the left,  agree=0.736, adj=0.159, (0 split)
##
## Node number 71: 36 observations
##   predicted class=1  expected loss=0.3611111  P(node) =0.08695652
##     class counts:    13    23
##    probabilities: 0.361 0.639
##
## Node number 140: 96 observations,    complexity param=0.01143791
##   predicted class=0  expected loss=0.3020833  P(node) =0.2318841
##     class counts:    67    29
##    probabilities: 0.698 0.302
##   left son=280 (13 obs) right son=281 (83 obs)
##   Primary splits:
##       DC          < 79.15  to the left,  improve=2.744227, (0 missing)
##       DMC         < 38.8   to the left,  improve=2.300119, (0 missing)
##       ISI         < 7.75   to the left,  improve=1.545600, (0 missing)
##       temperature < 16     to the left,  improve=1.173611, (0 missing)
##       FFMC        < 88.15  to the left,  improve=1.108044, (0 missing)
##   Surrogate splits:
##       DMC         < 30.35  to the left,  agree=0.979, adj=0.846, (0 split)
##       FFMC        < 88.15  to the left,  agree=0.917, adj=0.385, (0 split)
##       ISI         < 4.4    to the left,  agree=0.906, adj=0.308, (0 split)
##       temperature < 14.25  to the left,  agree=0.896, adj=0.231, (0 split)
##
## Node number 141: 44 observations,    complexity param=0.01633987
##   predicted class=1  expected loss=0.4772727  P(node) =0.1062802
##     class counts:    21    23
##    probabilities: 0.477 0.523
##   left son=282 (36 obs) right son=283 (8 obs)
##   Primary splits:
##       temperature       < 12.35  to the left,  improve=2.426768, (0 missing)
##       DC                < 57.1   to the right, improve=2.424631, (0 missing)
##       relative humidity < 75.5   to the right, improve=2.402422, (0 missing)
##       DMC               < 18.7   to the right, improve=2.018913, (0 missing)
##       ISI               < 4      to the right, improve=1.227273, (0 missing)
##   Surrogate splits:
##       DC < 696.25 to the left,  agree=0.841, adj=0.125, (0 split)
##
```

```
## Node number 280: 13 observations
##   predicted class=0  expected loss=0  P(node) =0.03140097
##     class counts:    13     0
##    probabilities: 1.000 0.000
##
## Node number 281: 83 observations,    complexity param=0.01143791
##   predicted class=0  expected loss=0.3493976  P(node) =0.2004831
##     class counts:    54    29
##    probabilities: 0.651 0.349
##   left son=562 (56 obs) right son=563 (27 obs)
##   Primary splits:
##       temperature       < 17.2   to the right, improve=2.2891730, (0 missing)
##       FFMC              < 90.15  to the right, improve=1.2388610, (0 missing)
##       ISI               < 9.35   to the left,  improve=1.1154590, (0 missing)
##       DC                < 697.35 to the right, improve=1.0390440, (0 missing)
##       relative humidity < 42.5   to the left,  improve=0.6673407, (0 missing)
##   Surrogate splits:
##       DMC               < 60.5   to the right, agree=0.771, adj=0.296, (0 split)
##       DC                < 100.55 to the right, agree=0.747, adj=0.222, (0 split)
##       relative humidity < 52.5   to the left,  agree=0.711, adj=0.111, (0 split)
##       wind speeds       < 1.1    to the right, agree=0.711, adj=0.111, (0 split)
##
## Node number 282: 36 observations,    complexity param=0.01633987
##   predicted class=0  expected loss=0.4444444  P(node) =0.08695652
##     class counts:    20    16
##    probabilities: 0.556 0.444
##   left son=564 (27 obs) right son=565 (9 obs)
##   Primary splits:
##       ISI               < 3.9    to the right, improve=2.666667, (0 missing)
##       DC                < 60.8   to the right, improve=2.539683, (0 missing)
##       DMC               < 18.7   to the right, improve=2.500186, (0 missing)
##       relative humidity < 71     to the right, improve=2.099206, (0 missing)
##       FFMC              < 85.05  to the right, improve=1.265463, (0 missing)
##   Surrogate splits:
##       FFMC        < 85.15  to the right, agree=0.917, adj=0.667, (0 split)
##       DMC         < 11.15  to the right, agree=0.861, adj=0.444, (0 split)
##       temperature < 6.25   to the right, agree=0.833, adj=0.333, (0 split)
##       DC          < 22.65  to the right, agree=0.778, adj=0.111, (0 split)
##
## Node number 283: 8 observations
##   predicted class=1  expected loss=0.125  P(node) =0.01932367
##     class counts:     1     7
##    probabilities: 0.125 0.875
##
## Node number 562: 56 observations
##   predicted class=0  expected loss=0.2678571  P(node) =0.1352657
##     class counts:    41    15
##    probabilities: 0.732 0.268
##
## Node number 563: 27 observations,    complexity param=0.01143791
##   predicted class=1  expected loss=0.4814815  P(node) =0.06521739
##     class counts:    13    14
##    probabilities: 0.481 0.519
##   left son=1126 (14 obs) right son=1127 (13 obs)
```

```
##   Primary splits:
##       temperature < 16     to the left,  improve=3.1518110, (0 missing)
##       DMC         < 48.4   to the left,  improve=1.5167760, (0 missing)
##       wind speeds < 2.9    to the left,  improve=1.0243390, (0 missing)
##       FFMC        < 90.65  to the right, improve=0.9481481, (0 missing)
##       ISI         < 8.75   to the right, improve=0.8990639, (0 missing)
##   Surrogate splits:
##       DC                < 627.7  to the left,  agree=0.741, adj=0.462, (0 split)
##       FFMC              < 91.55  to the left,  agree=0.667, adj=0.308, (0 split)
##       DMC               < 98.25  to the left,  agree=0.667, adj=0.308, (0 split)
##       ISI               < 9.25   to the left,  agree=0.667, adj=0.308, (0 split)
##       relative humidity < 39     to the left,  agree=0.630, adj=0.231, (0 split)
##
## Node number 564: 27 observations
##   predicted class=0  expected loss=0.3333333  P(node) =0.06521739
##     class counts:    18     9
##    probabilities: 0.667 0.333
##
## Node number 565: 9 observations
##   predicted class=1  expected loss=0.2222222  P(node) =0.02173913
##     class counts:     2     7
##    probabilities: 0.222 0.778
##
## Node number 1126: 14 observations
##   predicted class=0  expected loss=0.2857143  P(node) =0.03381643
##     class counts:    10     4
##    probabilities: 0.714 0.286
##
## Node number 1127: 13 observations
##   predicted class=1  expected loss=0.2307692  P(node) =0.03140097
##     class counts:     3    10
##    probabilities: 0.231 0.769
```

```
rpart.plot(dt, box.palette="RdBu", shadow.col="gray", nn=TRUE)
```




```
y_pred = predict(dt, newdata = ff4[,-9])
rfp <- as.data.frame(y_pred)
rfp$'0' <- as.factor(rfp$'0')
rfp$'1' <- as.factor(rfp$'1')
rfa <- as.data.frame(ff4[,9])
rfa$`fire__no_yes` <- as.factor(rfa$`ff4[, 9]`)
rfa$`fire__no_yes` <- as.factor(rfa$`fire__no_yes`)
length(rfa$`fire__no_yes`)
```

```
## [1] 414
```

```
length(rfp$y_pred)
```

```
## [1] 0
```

```
# confusionMatrix(rfp, rfa)

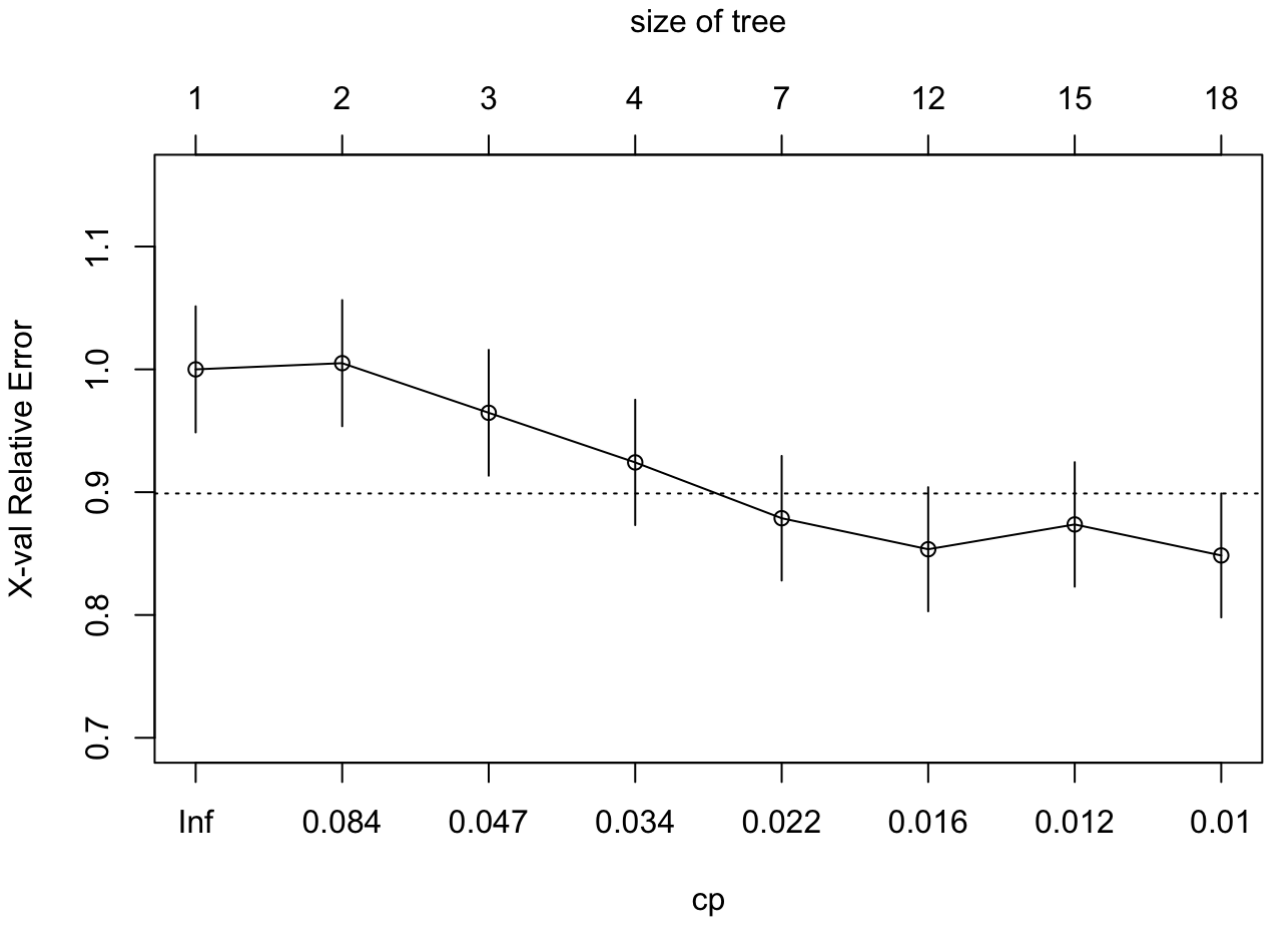

set.seed(1016)
index2 <- sample(1:nrow(ff3), round(nrow(ff3)*.8))
ff5 <- ff3[index2,]
dt <- rpart(ff5$fire__no_yes ~., method = 'class', data = ff5)
dt
```

```
## n= 414
##
## node), split, n, loss, yval, (yprob)
##       * denotes terminal node
##
##   1) root 414 198 1 (0.4782609 0.5217391)
##     2) DMC< 88.1 127  51 0 (0.5984252 0.4015748)
##       4) temperature>=5.15 117  42 0 (0.6410256 0.3589744)
##         8) relative humidity< 24.5 10   0 0 (1.0000000 0.0000000) *
##         9) relative humidity>=24.5 107  42 0 (0.6074766 0.3925234)
##          18) relative humidity>=71.5 9   0 0 (1.0000000 0.0000000) *
##          19) relative humidity< 71.5 98  42 0 (0.5714286 0.4285714)
##            38) relative humidity< 52.5 80  28 0 (0.6500000 0.3500000)
##              76) ISI< 5.65 24   3 0 (0.8750000 0.1250000) *
##              77) ISI>=5.65 56  25 0 (0.5535714 0.4464286)
##               154) DC>=433.5 27   7 0 (0.7407407 0.2592593) *
##               155) DC< 433.5 29  11 1 (0.3793103 0.6206897)
##                 310) temperature< 12.4 9   3 0 (0.6666667 0.3333333) *
##                 311) temperature>=12.4 20   5 1 (0.2500000 0.7500000) *
##            39) relative humidity>=52.5 18   4 1 (0.2222222 0.7777778) *
##       5) temperature< 5.15 10   1 1 (0.1000000 0.9000000) *
##     3) DMC>=88.1 287 122 1 (0.4250871 0.5749129)
##       6) ISI< 6.35 29   9 0 (0.6896552 0.3103448) *
##       7) ISI>=6.35 258 102 1 (0.3953488 0.6046512)
##        14) DMC>=133.45 130  62 1 (0.4769231 0.5230769)
##          28) temperature< 21.65 61  25 0 (0.5901639 0.4098361)
##            56) ISI>=7.85 43  13 0 (0.6976744 0.3023256)
##             112) ISI< 13.8 31   6 0 (0.8064516 0.1935484) *
##             113) ISI>=13.8 12   5 1 (0.4166667 0.5833333) *
##            57) ISI< 7.85 18   6 1 (0.3333333 0.6666667) *
##          29) temperature>=21.65 69  26 1 (0.3768116 0.6231884)
##            58) DC>=703.55 23  11 0 (0.5217391 0.4782609)
##             116) FFMC< 93.35 8   2 0 (0.7500000 0.2500000) *
##             117) FFMC>=93.35 15   6 1 (0.4000000 0.6000000) *
##            59) DC< 703.55 46  14 1 (0.3043478 0.6956522) *
##        15) DMC< 133.45 128  40 1 (0.3125000 0.6875000)
##          30) relative humidity< 27.5 26  13 0 (0.5000000 0.5000000)
##            60) FFMC< 92.85 16   5 0 (0.6875000 0.3125000) *
##            61) FFMC>=92.85 10   2 1 (0.2000000 0.8000000) *
##          31) relative humidity>=27.5 102  27 1 (0.2647059 0.7352941) *
```

```
printcp(dt) # display the results
```

```
##
## Classification tree:
## rpart(formula = ff5$fire__no_yes ~ ., data = ff5, method = "class")
##
## Variables actually used in tree construction:
## [1] DC                DMC               FFMC              ISI
## [5] relative humidity temperature
##
## Root node error: 198/414 = 0.47826
##
## n= 414
##
##         CP nsplit rel error  xerror     xstd
## 1 0.126263      0   1.00000 1.00000 0.051333
## 2 0.055556      1   0.87374 1.00505 0.051343
## 3 0.040404      2   0.81818 0.96465 0.051228
## 4 0.027778      3   0.77778 0.92424 0.051035
## 5 0.016835      6   0.69192 0.87879 0.050724
## 6 0.015152     11   0.60606 0.85354 0.050508
## 7 0.010101     14   0.56061 0.87374 0.050683
## 8 0.010000     17   0.53030 0.84848 0.050461
```

```
plotcp(dt) # visualize cross-validation results
```



```
summary(dt)
```

```
## Call:
## rpart(formula = ff5$fire__no_yes ~ ., data = ff5, method = "class")
##   n= 414
##
##           CP nsplit rel error    xerror       xstd
## 1 0.12626263      0 1.0000000 1.0000000 0.05133270
## 2 0.05555556      1 0.8737374 1.0050505 0.05134290
## 3 0.04040404      2 0.8181818 0.9646465 0.05122757
## 4 0.02777778      3 0.7777778 0.9242424 0.05103477
## 5 0.01683502      6 0.6919192 0.8787879 0.05072416
## 6 0.01515152     11 0.6060606 0.8535354 0.05050810
## 7 0.01010101     14 0.5606061 0.8737374 0.05068345
## 8 0.01000000     17 0.5303030 0.8484848 0.05046111
##
## Variable importance
##               ISI              FFMC               DMC relative humidity
##                19                16                16                16
##       temperature                DC       wind speeds
##                16                14                 2
##
## Node number 1: 414 observations,    complexity param=0.1262626
##   predicted class=1  expected loss=0.4782609  P(node) =1
##     class counts:   198   216
##    probabilities: 0.478 0.522
##   left son=2 (127 obs) right son=3 (287 obs)
##   Primary splits:
##       DMC         < 88.1   to the left,  improve=5.290580, (0 missing)
##       temperature < 19.85  to the left,  improve=4.832407, (0 missing)
##       ISI         < 6.35   to the left,  improve=3.333932, (0 missing)
##       wind speeds < 7.8    to the left,  improve=3.260124, (0 missing)
##       DC          < 243.2  to the left,  improve=3.209009, (0 missing)
##   Surrogate splits:
##       DC          < 376.9  to the left,  agree=0.867, adj=0.567, (0 split)
##       FFMC        < 88.25  to the left,  agree=0.819, adj=0.409, (0 split)
##       ISI         < 5.75   to the left,  agree=0.812, adj=0.386, (0 split)
##       temperature < 15.3   to the left,  agree=0.775, adj=0.268, (0 split)
##       wind speeds < 7.8    to the right, agree=0.708, adj=0.047, (0 split)
##
## Node number 2: 127 observations,    complexity param=0.04040404
##   predicted class=0  expected loss=0.4015748  P(node) =0.3067633
##     class counts:    76    51
##    probabilities: 0.598 0.402
##   left son=4 (117 obs) right son=5 (10 obs)
##   Primary splits:
##       temperature       < 5.15   to the right, improve=5.393216, (0 missing)
##       wind speeds       < 7.8    to the left,  improve=5.393216, (0 missing)
##       relative humidity < 52.5   to the left,  improve=3.159765, (0 missing)
##       FFMC              < 91.35  to the right, improve=3.010442, (0 missing)
##       DC                < 667.35 to the right, improve=2.859765, (0 missing)
##   Surrogate splits:
##       wind speeds < 8.25   to the left,  agree=0.929, adj=0.1, (0 split)
##
## Node number 3: 287 observations,    complexity param=0.05555556
```

```
##   predicted class=1  expected loss=0.4250871  P(node) =0.6932367
##     class counts:   122   165
##    probabilities: 0.425 0.575
##   left son=6 (29 obs) right son=7 (258 obs)
##   Primary splits:
##       ISI               < 6.35   to the left,  improve=4.516115, (0 missing)
##       FFMC              < 91.75  to the left,  improve=2.614203, (0 missing)
##       relative humidity < 55.5   to the right, improve=2.443404, (0 missing)
##       DMC               < 136.95 to the right, improve=2.216478, (0 missing)
##       temperature       < 19.85  to the left,  improve=2.096131, (0 missing)
##
## Node number 4: 117 observations,    complexity param=0.01683502
##   predicted class=0  expected loss=0.3589744  P(node) =0.2826087
##     class counts:    75    42
##    probabilities: 0.641 0.359
##   left son=8 (10 obs) right son=9 (107 obs)
##   Primary splits:
##       relative humidity < 24.5   to the left,  improve=2.818116, (0 missing)
##       DC                < 667.35 to the right, improve=1.732183, (0 missing)
##       FFMC              < 91.35  to the right, improve=1.671571, (0 missing)
##       DMC               < 69.15  to the right, improve=1.466281, (0 missing)
##       temperature       < 23.1   to the left,  improve=1.435613, (0 missing)
##
## Node number 5: 10 observations
##   predicted class=1  expected loss=0.1  P(node) =0.02415459
##     class counts:     1     9
##    probabilities: 0.100 0.900
##
## Node number 6: 29 observations
##   predicted class=0  expected loss=0.3103448  P(node) =0.07004831
##     class counts:    20     9
##    probabilities: 0.690 0.310
##
## Node number 7: 258 observations,    complexity param=0.02777778
##   predicted class=1  expected loss=0.3953488  P(node) =0.6231884
##     class counts:   102   156
##    probabilities: 0.395 0.605
##   left son=14 (130 obs) right son=15 (128 obs)
##   Primary splits:
##       DMC               < 133.45 to the right, improve=3.487299, (0 missing)
##       relative humidity < 57.5   to the right, improve=3.002148, (0 missing)
##       temperature       < 12.7   to the left,  improve=1.852902, (0 missing)
##       DC                < 499.6  to the left,  improve=1.417553, (0 missing)
##       FFMC              < 89.9   to the left,  improve=1.334851, (0 missing)
##   Surrogate splits:
##       FFMC              < 92.85  to the right, agree=0.640, adj=0.273, (0 split)
##       ISI               < 10.5   to the right, agree=0.640, adj=0.273, (0 split)
##       temperature       < 21.65  to the right, agree=0.612, adj=0.219, (0 split)
##       DC                < 590.65 to the right, agree=0.605, adj=0.203, (0 split)
##       relative humidity < 57.5   to the right, agree=0.578, adj=0.148, (0 split)
##
## Node number 8: 10 observations
##   predicted class=0  expected loss=0  P(node) =0.02415459
##     class counts:    10     0
```

```
##    probabilities: 1.000 0.000
##
## Node number 9: 107 observations,    complexity param=0.01683502
##   predicted class=0  expected loss=0.3925234  P(node) =0.2584541
##     class counts:    65    42
##    probabilities: 0.607 0.393
##   left son=18 (9 obs) right son=19 (98 obs)
##   Primary splits:
##       relative humidity < 71.5   to the right, improve=3.028037, (0 missing)
##       temperature       < 24.15  to the left,  improve=2.209856, (0 missing)
##       DMC               < 69.15  to the right, improve=1.854704, (0 missing)
##       DC                < 667.35 to the right, improve=1.540696, (0 missing)
##       ISI               < 11.05  to the left,  improve=1.087103, (0 missing)
##   Surrogate splits:
##       FFMC < 71.5   to the left,  agree=0.944, adj=0.333, (0 split)
##       ISI  < 0.95   to the left,  agree=0.944, adj=0.333, (0 split)
##
## Node number 14: 130 observations,    complexity param=0.02777778
##   predicted class=1  expected loss=0.4769231  P(node) =0.3140097
##     class counts:    62    68
##    probabilities: 0.477 0.523
##   left son=28 (61 obs) right son=29 (69 obs)
##   Primary splits:
##       temperature       < 21.65  to the left,  improve=2.947545, (0 missing)
##       relative humidity < 24.5   to the left,  improve=2.701702, (0 missing)
##       FFMC              < 91.55  to the left,  improve=2.165810, (0 missing)
##       ISI               < 12.85  to the left,  improve=1.641042, (0 missing)
##       DMC               < 148.55 to the left,  improve=1.400101, (0 missing)
##   Surrogate splits:
##       relative humidity < 42.5   to the right, agree=0.815, adj=0.607, (0 split)
##       FFMC              < 91.55  to the left,  agree=0.769, adj=0.508, (0 split)
##       ISI               < 10.85  to the left,  agree=0.669, adj=0.295, (0 split)
##       DC                < 729.6  to the right, agree=0.631, adj=0.213, (0 split)
##       DMC               < 233.1  to the right, agree=0.623, adj=0.197, (0 split)
##
## Node number 15: 128 observations,    complexity param=0.01515152
##   predicted class=1  expected loss=0.3125  P(node) =0.3091787
##     class counts:    40    88
##    probabilities: 0.312 0.688
##   left son=30 (26 obs) right son=31 (102 obs)
##   Primary splits:
##       relative humidity < 27.5   to the left,  improve=2.294118, (0 missing)
##       FFMC              < 92.85  to the left,  improve=1.870635, (0 missing)
##       DMC               < 126.8  to the left,  improve=1.848552, (0 missing)
##       DC                < 499.6  to the left,  improve=1.657227, (0 missing)
##       temperature       < 15.75  to the left,  improve=1.285714, (0 missing)
##   Surrogate splits:
##       temperature < 24     to the right, agree=0.883, adj=0.423, (0 split)
##       DMC         < 132    to the right, agree=0.812, adj=0.077, (0 split)
##
## Node number 18: 9 observations
##   predicted class=0  expected loss=0  P(node) =0.02173913
##     class counts:     9     0
##    probabilities: 1.000 0.000
```

```
##
## Node number 19: 98 observations,    complexity param=0.01683502
##   predicted class=0  expected loss=0.4285714  P(node) =0.236715
##     class counts:    56    42
##    probabilities: 0.571 0.429
##   left son=38 (80 obs) right son=39 (18 obs)
##   Primary splits:
##       relative humidity < 52.5   to the left,  improve=5.377778, (0 missing)
##       DC                < 667.35 to the right, improve=2.136672, (0 missing)
##       DMC               < 69.15  to the right, improve=1.921039, (0 missing)
##       temperature       < 24.15  to the left,  improve=1.800000, (0 missing)
##       FFMC              < 92.25  to the right, improve=1.602564, (0 missing)
##   Surrogate splits:
##       temperature < 6.65   to the right, agree=0.867, adj=0.278, (0 split)
##       DMC         < 9.2    to the right, agree=0.837, adj=0.111, (0 split)
##       DC          < 727.65 to the left,  agree=0.837, adj=0.111, (0 split)
##       FFMC        < 83.95  to the right, agree=0.827, adj=0.056, (0 split)
##
## Node number 28: 61 observations,    complexity param=0.02777778
##   predicted class=0  expected loss=0.4098361  P(node) =0.147343
##     class counts:    36    25
##    probabilities: 0.590 0.410
##   left son=56 (43 obs) right son=57 (18 obs)
##   Primary splits:
##       ISI         < 7.85   to the right, improve=3.368662, (0 missing)
##       DC          < 818.3  to the left,  improve=2.704560, (0 missing)
##       wind speeds < 2.45   to the left,  improve=2.296432, (0 missing)
##       DMC         < 263.7  to the left,  improve=2.014079, (0 missing)
##       FFMC        < 91.15  to the right, improve=1.578372, (0 missing)
##   Surrogate splits:
##       DC          < 729.6  to the left,  agree=0.902, adj=0.667, (0 split)
##       FFMC        < 91.15  to the right, agree=0.852, adj=0.500, (0 split)
##       DMC         < 236.65 to the left,  agree=0.836, adj=0.444, (0 split)
##       wind speeds < 6.95   to the left,  agree=0.738, adj=0.111, (0 split)
##
## Node number 29: 69 observations,    complexity param=0.01010101
##   predicted class=1  expected loss=0.3768116  P(node) =0.1666667
##     class counts:    26    43
##    probabilities: 0.377 0.623
##   left son=58 (23 obs) right son=59 (46 obs)
##   Primary splits:
##       DC          < 703.55 to the right, improve=1.4492750, (0 missing)
##       FFMC        < 92.8   to the right, improve=1.1639670, (0 missing)
##       ISI         < 9.05   to the right, improve=1.1617490, (0 missing)
##       wind speeds < 4.7    to the left,  improve=0.9057971, (0 missing)
##       DMC         < 209.55 to the right, improve=0.8371158, (0 missing)
##   Surrogate splits:
##       DMC  < 224.7  to the right, agree=0.783, adj=0.348, (0 split)
##       ISI  < 9.35   to the left,  agree=0.783, adj=0.348, (0 split)
##       FFMC < 91.3   to the left,  agree=0.710, adj=0.130, (0 split)
##
## Node number 30: 26 observations,    complexity param=0.01515152
##   predicted class=0  expected loss=0.5  P(node) =0.06280193
##     class counts:    13    13
```

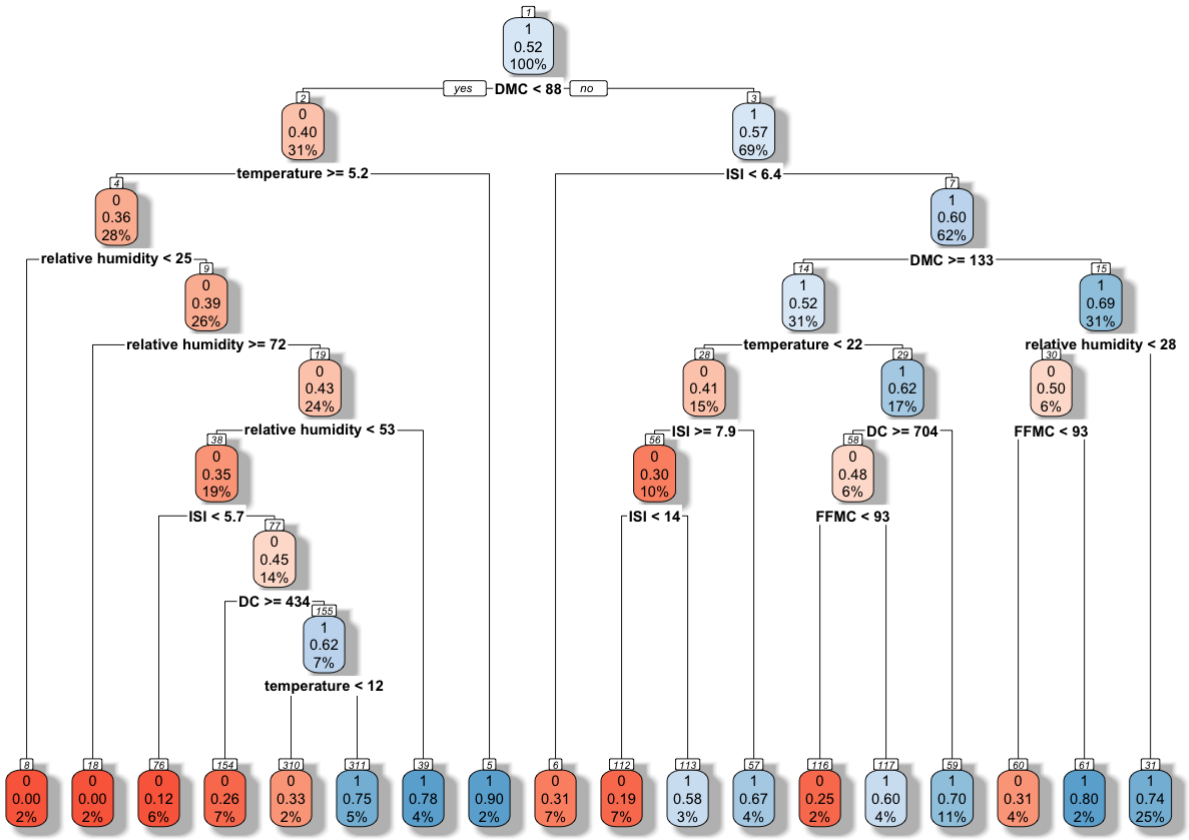
```
##    probabilities: 0.500 0.500
##   left son=60 (16 obs) right son=61 (10 obs)
##   Primary splits:
##       FFMC              < 92.85  to the left,  improve=2.925000, (0 missing)
##       relative humidity < 26     to the right, improve=2.785714, (0 missing)
##       wind speeds       < 4.7    to the right, improve=2.443609, (0 missing)
##       DC                < 745.45 to the right, improve=2.124183, (0 missing)
##       ISI               < 8.55   to the left,  improve=1.444444, (0 missing)
##   Surrogate splits:
##       ISI               < 9      to the left,  agree=0.885, adj=0.7, (0 split)
##       temperature       < 25.85  to the left,  agree=0.846, adj=0.6, (0 split)
##       DMC               < 125.75 to the left,  agree=0.808, adj=0.5, (0 split)
##       DC                < 719.5  to the right, agree=0.808, adj=0.5, (0 split)
##       relative humidity < 23     to the right, agree=0.808, adj=0.5, (0 split)
##
## Node number 31: 102 observations
##   predicted class=1  expected loss=0.2647059  P(node) =0.2463768
##     class counts:    27    75
##    probabilities: 0.265 0.735
##
## Node number 38: 80 observations,    complexity param=0.01683502
##   predicted class=0  expected loss=0.35  P(node) =0.1932367
##     class counts:    52    28
##    probabilities: 0.650 0.350
##   left son=76 (24 obs) right son=77 (56 obs)
##   Primary splits:
##       ISI               < 5.65   to the left,  improve=3.471429, (0 missing)
##       relative humidity < 29.5   to the right, improve=3.025000, (0 missing)
##       temperature       < 24.15  to the left,  improve=2.844444, (0 missing)
##       DMC               < 35.6   to the left,  improve=2.625455, (0 missing)
##       FFMC              < 88.95  to the left,  improve=2.304762, (0 missing)
##   Surrogate splits:
##       FFMC < 88.35  to the left,  agree=0.962, adj=0.875, (0 split)
##       DMC  < 29.05  to the left,  agree=0.788, adj=0.292, (0 split)
##       DC   < 70.65  to the left,  agree=0.775, adj=0.250, (0 split)
##
## Node number 39: 18 observations
##   predicted class=1  expected loss=0.2222222  P(node) =0.04347826
##     class counts:     4    14
##    probabilities: 0.222 0.778
##
## Node number 56: 43 observations,    complexity param=0.01010101
##   predicted class=0  expected loss=0.3023256  P(node) =0.1038647
##     class counts:    30    13
##    probabilities: 0.698 0.302
##   left son=112 (31 obs) right son=113 (12 obs)
##   Primary splits:
##       ISI         < 13.8   to the left,  improve=2.628782, (0 missing)
##       FFMC        < 92.05  to the left,  improve=2.481526, (0 missing)
##       temperature < 18.4   to the left,  improve=2.263979, (0 missing)
##       wind speeds < 2.45   to the left,  improve=1.066808, (0 missing)
##       DMC         < 156.3  to the right, improve=1.055791, (0 missing)
##   Surrogate splits:
##       FFMC        < 93.8   to the left,  agree=0.860, adj=0.500, (0 split)
```

```
##       DMC         < 141.85 to the right, agree=0.767, adj=0.167, (0 split)
##       rain amount < 0.3    to the left,  agree=0.767, adj=0.167, (0 split)
##       DC          < 597.8  to the right, agree=0.744, adj=0.083, (0 split)
##
## Node number 57: 18 observations
##   predicted class=1  expected loss=0.3333333  P(node) =0.04347826
##     class counts:     6    12
##    probabilities: 0.333 0.667
##
## Node number 58: 23 observations,    complexity param=0.01010101
##   predicted class=0  expected loss=0.4782609  P(node) =0.05555556
##     class counts:    12    11
##    probabilities: 0.522 0.478
##   left son=116 (8 obs) right son=117 (15 obs)
##   Primary splits:
##       FFMC        < 93.35  to the left,  improve=1.278261, (0 missing)
##       DC          < 714.5  to the left,  improve=1.278261, (0 missing)
##       ISI         < 8.8    to the right, improve=1.124415, (0 missing)
##       wind speeds < 3.35   to the right, improve=1.124415, (0 missing)
##       temperature < 26.55  to the left,  improve=1.049689, (0 missing)
##   Surrogate splits:
##       DMC         < 143.3  to the left,  agree=0.870, adj=0.625, (0 split)
##       DC          < 706.55 to the left,  agree=0.783, adj=0.375, (0 split)
##       wind speeds < 2      to the left,  agree=0.783, adj=0.375, (0 split)
##       ISI         < 7.6    to the left,  agree=0.739, adj=0.250, (0 split)
##       temperature < 22.6   to the left,  agree=0.696, adj=0.125, (0 split)
##
## Node number 59: 46 observations
##   predicted class=1  expected loss=0.3043478  P(node) =0.1111111
##     class counts:    14    32
##    probabilities: 0.304 0.696
##
## Node number 60: 16 observations
##   predicted class=0  expected loss=0.3125  P(node) =0.03864734
##     class counts:    11     5
##    probabilities: 0.688 0.312
##
## Node number 61: 10 observations
##   predicted class=1  expected loss=0.2  P(node) =0.02415459
##     class counts:     2     8
##    probabilities: 0.200 0.800
##
## Node number 76: 24 observations
##   predicted class=0  expected loss=0.125  P(node) =0.05797101
##     class counts:    21     3
##    probabilities: 0.875 0.125
##
## Node number 77: 56 observations,    complexity param=0.01683502
##   predicted class=0  expected loss=0.4464286  P(node) =0.1352657
##     class counts:    31    25
##    probabilities: 0.554 0.446
##   left son=154 (27 obs) right son=155 (29 obs)
##   Primary splits:
##       DC                < 433.5  to the right, improve=3.653029, (0 missing)
```

```
##       temperature       < 23.1   to the left,  improve=3.428571, (0 missing)
##       FFMC              < 91.35  to the right, improve=2.678571, (0 missing)
##       relative humidity < 28.5   to the right, improve=2.159380, (0 missing)
##       DMC               < 83.5   to the right, improve=1.916955, (0 missing)
##   Surrogate splits:
##       DMC               < 61.7   to the right, agree=0.893, adj=0.778, (0 split)
##       FFMC              < 91.75  to the right, agree=0.804, adj=0.593, (0 split)
##       temperature       < 17.3   to the right, agree=0.768, adj=0.519, (0 split)
##       relative humidity < 31.5   to the right, agree=0.696, adj=0.370, (0 split)
##       ISI               < 10.45  to the right, agree=0.661, adj=0.296, (0 split)
##
## Node number 112: 31 observations
##   predicted class=0  expected loss=0.1935484  P(node) =0.07487923
##     class counts:    25     6
##    probabilities: 0.806 0.194
##
## Node number 113: 12 observations
##   predicted class=1  expected loss=0.4166667  P(node) =0.02898551
##     class counts:     5     7
##    probabilities: 0.417 0.583
##
## Node number 116: 8 observations
##   predicted class=0  expected loss=0.25  P(node) =0.01932367
##     class counts:     6     2
##    probabilities: 0.750 0.250
##
## Node number 117: 15 observations
##   predicted class=1  expected loss=0.4  P(node) =0.03623188
##     class counts:     6     9
##    probabilities: 0.400 0.600
##
## Node number 154: 27 observations
##   predicted class=0  expected loss=0.2592593  P(node) =0.06521739
##     class counts:    20     7
##    probabilities: 0.741 0.259
##
## Node number 155: 29 observations,    complexity param=0.01515152
##   predicted class=1  expected loss=0.3793103  P(node) =0.07004831
##     class counts:    11    18
##    probabilities: 0.379 0.621
##   left son=310 (9 obs) right son=311 (20 obs)
##   Primary splits:
##       temperature < 12.4   to the left,  improve=2.155172, (0 missing)
##       FFMC        < 90.85  to the right, improve=1.998030, (0 missing)
##       ISI         < 7.4    to the right, improve=1.877395, (0 missing)
##       wind speeds < 3.8    to the right, improve=1.877395, (0 missing)
##       DMC         < 37.75  to the left,  improve=1.193634, (0 missing)
##   Surrogate splits:
##       FFMC              < 89.45  to the left,  agree=0.828, adj=0.444, (0 split)
##       DMC               < 19.75  to the left,  agree=0.793, adj=0.333, (0 split)
##       DC                < 42.3   to the left,  agree=0.793, adj=0.333, (0 split)
##       relative humidity < 34.5   to the right, agree=0.759, adj=0.222, (0 split)
##       wind speeds       < 5.6    to the right, agree=0.759, adj=0.222, (0 split)
##
```

```
## Node number 310: 9 observations
##   predicted class=0  expected loss=0.3333333  P(node) =0.02173913
##     class counts:     6     3
##    probabilities: 0.667 0.333
##
## Node number 311: 20 observations
##   predicted class=1  expected loss=0.25  P(node) =0.04830918
##     class counts:     5    15
##    probabilities: 0.250 0.750
```

```
rpart.plot(dt, box.palette="RdBu", shadow.col="gray", nn=TRUE)
```



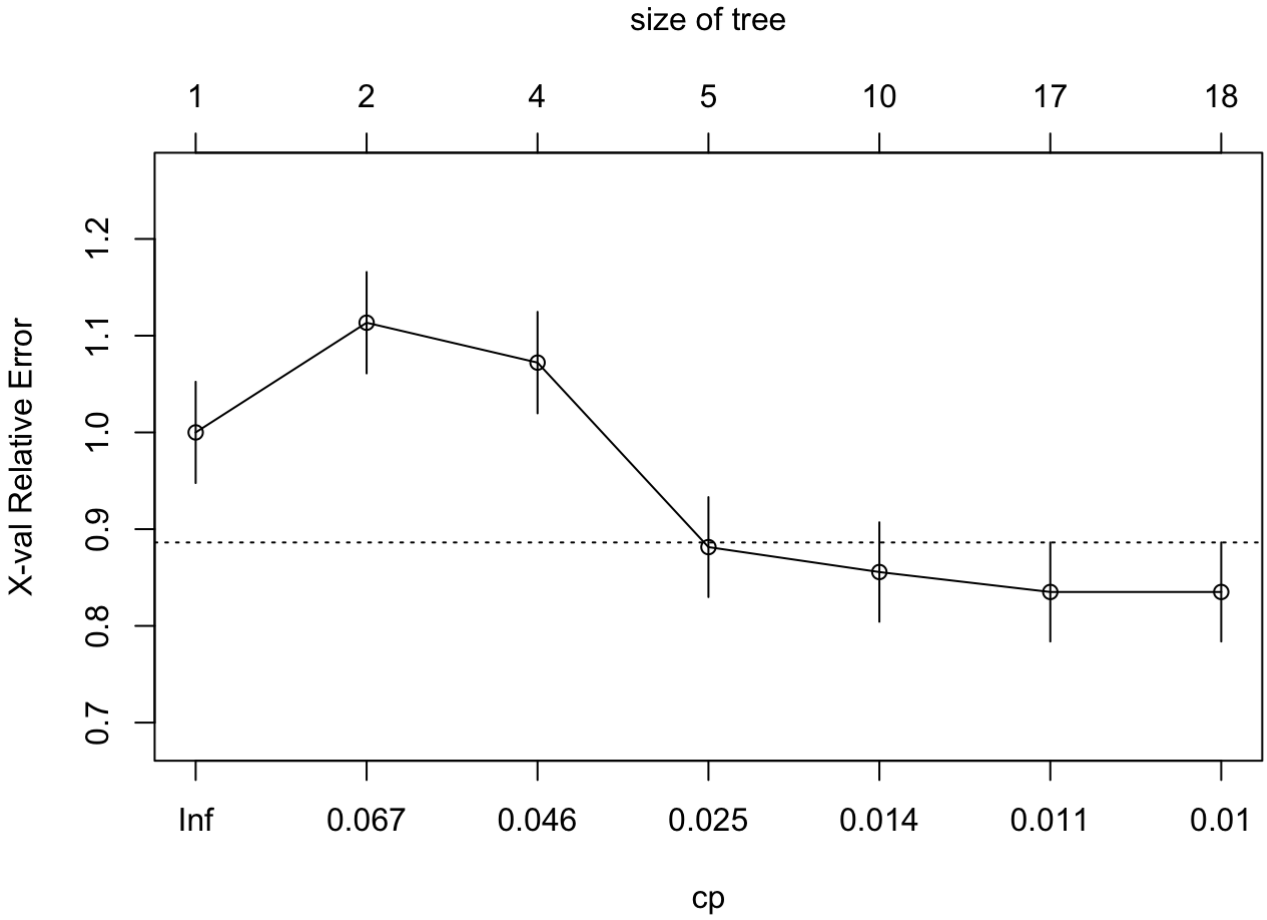

```
set.seed(69)
index3 <- sample(1:nrow(ff3), round(nrow(ff3)*.8))
ff6 <- ff3[index3,]
dt <- rpart(ff6$fire__no_yes ~., method = 'class', data = ff6)
dt
```

```
## n= 414
##
## node), split, n, loss, yval, (yprob)
##       * denotes terminal node
##
##    1) root 414 194 1 (0.4685990 0.5314010)
##      2) temperature< 19.85 227 105 0 (0.5374449 0.4625551)
##        4) wind speeds< 7.8 213  93 0 (0.5633803 0.4366197)
##          8) DC< 731.45 167  65 0 (0.6107784 0.3892216)
##           16) relative humidity< 38.5 42   9 0 (0.7857143 0.2142857) *
##           17) relative humidity>=38.5 125  56 0 (0.5520000 0.4480000)
##             34) DMC>=141.85 21   5 0 (0.7619048 0.2380952) *
##             35) DMC< 141.85 104  51 0 (0.5096154 0.4903846)
##               70) FFMC< 86.7 25   8 0 (0.6800000 0.3200000)
##                140) temperature>=10.35 12   0 0 (1.0000000 0.0000000) *
##                141) temperature< 10.35 13   5 1 (0.3846154 0.6153846) *
##               71) FFMC>=86.7 79  36 1 (0.4556962 0.5443038)
##                142) relative humidity>=47.5 43  19 0 (0.5581395 0.4418605)
##                  284) relative humidity< 52.5 9   0 0 (1.0000000 0.0000000) *
##                  285) relative humidity>=52.5 34  15 1 (0.4411765 0.5588235)
##                    570) relative humidity>=57 24  10 0 (0.5833333 0.4166667)
##                     1140) ISI>=6.65 16   5 0 (0.6875000 0.3125000) *
##                     1141) ISI< 6.65 8   3 1 (0.3750000 0.6250000) *
##                    571) relative humidity< 57 10   1 1 (0.1000000 0.9000000) *
##                143) relative humidity< 47.5 36  12 1 (0.3333333 0.6666667) *
##          9) DC>=731.45 46  18 1 (0.3913043 0.6086957)
##           18) ISI< 6.4 9   3 0 (0.6666667 0.3333333) *
##           19) ISI>=6.4 37  12 1 (0.3243243 0.6756757) *
##        5) wind speeds>=7.8 14   2 1 (0.1428571 0.8571429) *
##      3) temperature>=19.85 187  72 1 (0.3850267 0.6149733)
##        6) relative humidity< 24.5 14   3 0 (0.7857143 0.2142857) *
##        7) relative humidity>=24.5 173  61 1 (0.3526012 0.6473988)
##         14) temperature< 26.25 137  54 1 (0.3941606 0.6058394)
##           28) FFMC>=92.15 65  32 1 (0.4923077 0.5076923)
##             56) DMC>=168.65 15   3 0 (0.8000000 0.2000000) *
##             57) DMC< 168.65 50  20 1 (0.4000000 0.6000000)
##              114) FFMC< 92.85 20   7 0 (0.6500000 0.3500000) *
##              115) FFMC>=92.85 30   7 1 (0.2333333 0.7666667) *
##           29) FFMC< 92.15 72  22 1 (0.3055556 0.6944444) *
##         15) temperature>=26.25 36   7 1 (0.1944444 0.8055556) *
```

```
printcp(dt) # display the results
```

```
##
## Classification tree:
## rpart(formula = ff6$fire__no_yes ~ ., data = ff6, method = "class")
##
## Variables actually used in tree construction:
## [1] DC                DMC               FFMC              ISI
## [5] relative humidity temperature       wind speeds
##
## Root node error: 194/414 = 0.4686
##
## n= 414
##
##         CP nsplit rel error  xerror     xstd
## 1 0.087629      0   1.00000 1.00000 0.052337
## 2 0.051546      1   0.91237 1.11340 0.052391
## 3 0.041237      3   0.80928 1.07216 0.052440
## 4 0.015464      4   0.76804 0.88144 0.051642
## 5 0.012027      9   0.67526 0.85567 0.051402
## 6 0.010309     16   0.55670 0.83505 0.051187
## 7 0.010000     17   0.54639 0.83505 0.051187
```

```
plotcp(dt) # visualize cross-validation results
```




```
summary(dt)
```

```
## Call:
## rpart(formula = ff6$fire__no_yes ~ ., data = ff6, method = "class")
##   n= 414
##
##           CP nsplit rel error    xerror       xstd
## 1 0.08762887      0 1.0000000 1.0000000 0.05233718
## 2 0.05154639      1 0.9123711 1.1134021 0.05239111
## 3 0.04123711      3 0.8092784 1.0721649 0.05244008
## 4 0.01546392      4 0.7680412 0.8814433 0.05164155
## 5 0.01202749      9 0.6752577 0.8556701 0.05140176
## 6 0.01030928     16 0.5567010 0.8350515 0.05118655
## 7 0.01000000     17 0.5463918 0.8350515 0.05118655
##
## Variable importance
## relative humidity       temperature               DMC              FFMC
##                27                17                15                13
##                DC               ISI       wind speeds       rain amount
##                11                10                 7                 1
##
## Node number 1: 414 observations,    complexity param=0.08762887
##   predicted class=1  expected loss=0.468599  P(node) =1
##     class counts:   194   220
##    probabilities: 0.469 0.531
##   left son=2 (227 obs) right son=3 (187 obs)
##   Primary splits:
##       temperature < 19.85  to the left,  improve=4.763989, (0 missing)
##       wind speeds < 7.8    to the left,  improve=3.929806, (0 missing)
##       DC          < 243.2  to the left,  improve=3.540300, (0 missing)
##       DMC         < 81.35  to the left,  improve=3.538537, (0 missing)
##       ISI         < 1.7    to the left,  improve=2.694659, (0 missing)
##   Surrogate splits:
##       FFMC              < 92.85  to the left,  agree=0.700, adj=0.337, (0 split)
##       relative humidity < 42.5   to the right, agree=0.693, adj=0.321, (0 split)
##       DMC               < 99.3   to the left,  agree=0.671, adj=0.273, (0 split)
##       DC                < 354.9  to the left,  agree=0.650, adj=0.225, (0 split)
##       ISI               < 8.05   to the left,  agree=0.645, adj=0.214, (0 split)
##
## Node number 2: 227 observations,    complexity param=0.05154639
##   predicted class=0  expected loss=0.4625551  P(node) =0.5483092
##     class counts:   122   105
##    probabilities: 0.537 0.463
##   left son=4 (213 obs) right son=5 (14 obs)
##   Primary splits:
##       wind speeds       < 7.8    to the left,  improve=4.646132, (0 missing)
##       temperature       < 7.85   to the right, improve=4.215924, (0 missing)
##       DC                < 767.15 to the left,  improve=3.099946, (0 missing)
##       DMC               < 141.85 to the right, improve=1.965279, (0 missing)
##       relative humidity < 84     to the right, improve=1.889692, (0 missing)
##   Surrogate splits:
##       temperature       < 5.15   to the right, agree=0.947, adj=0.143, (0 split)
##       relative humidity < 22.5   to the right, agree=0.943, adj=0.071, (0 split)
##
## Node number 3: 187 observations,    complexity param=0.04123711
```

```
##   predicted class=1  expected loss=0.3850267  P(node) =0.4516908
##     class counts:    72   115
##    probabilities: 0.385 0.615
##   left son=6 (14 obs) right son=7 (173 obs)
##   Primary splits:
##       relative humidity < 24.5   to the left,  improve=4.859205, (0 missing)
##       ISI               < 17.8   to the left,  improve=2.477937, (0 missing)
##       temperature       < 26     to the left,  improve=1.864612, (0 missing)
##       wind speeds       < 3.8    to the left,  improve=1.667494, (0 missing)
##       DC                < 613.85 to the right, improve=1.420892, (0 missing)
##   Surrogate splits:
##       DMC < 48     to the left,  agree=0.936, adj=0.143, (0 split)
##
## Node number 4: 213 observations,    complexity param=0.05154639
##   predicted class=0  expected loss=0.4366197  P(node) =0.5144928
##     class counts:   120    93
##    probabilities: 0.563 0.437
##   left son=8 (167 obs) right son=9 (46 obs)
##   Primary splits:
##       DC                < 731.45 to the left,  improve=3.474491, (0 missing)
##       DMC               < 81.35  to the left,  improve=3.217227, (0 missing)
##       relative humidity < 38.5   to the left,  improve=3.205420, (0 missing)
##       FFMC              < 84.5   to the left,  improve=1.806914, (0 missing)
##       ISI               < 1.95   to the left,  improve=1.249204, (0 missing)
##   Surrogate splits:
##       DMC         < 243.3  to the left,  agree=0.831, adj=0.217, (0 split)
##       temperature < 19.65  to the left,  agree=0.793, adj=0.043, (0 split)
##
## Node number 5: 14 observations
##   predicted class=1  expected loss=0.1428571  P(node) =0.03381643
##     class counts:     2    12
##    probabilities: 0.143 0.857
##
## Node number 6: 14 observations
##   predicted class=0  expected loss=0.2142857  P(node) =0.03381643
##     class counts:    11     3
##    probabilities: 0.786 0.214
##
## Node number 7: 173 observations,    complexity param=0.01546392
##   predicted class=1  expected loss=0.3526012  P(node) =0.4178744
##     class counts:    61   112
##    probabilities: 0.353 0.647
##   left son=14 (137 obs) right son=15 (36 obs)
##   Primary splits:
##       temperature       < 26.25  to the left,  improve=2.274224, (0 missing)
##       ISI               < 17.8   to the left,  improve=2.085689, (0 missing)
##       relative humidity < 26.5   to the right, improve=2.085689, (0 missing)
##       wind speeds       < 3.8    to the left,  improve=1.395720, (0 missing)
##       DC                < 693.7  to the right, improve=1.143698, (0 missing)
##   Surrogate splits:
##       relative humidity < 30.5   to the right, agree=0.821, adj=0.139, (0 split)
##       FFMC              < 95.7   to the left,  agree=0.809, adj=0.083, (0 split)
##       DMC               < 50.35  to the right, agree=0.803, adj=0.056, (0 split)
##       ISI               < 19     to the left,  agree=0.803, adj=0.056, (0 split)
```

```
##       DC                < 323.95 to the right, agree=0.798, adj=0.028, (0 split)
##
## Node number 8: 167 observations,    complexity param=0.01202749
##   predicted class=0  expected loss=0.3892216  P(node) =0.4033816
##     class counts:   102    65
##    probabilities: 0.611 0.389
##   left son=16 (42 obs) right son=17 (125 obs)
##   Primary splits:
##       relative humidity < 38.5   to the left,  improve=3.434340, (0 missing)
##       FFMC              < 91.15  to the right, improve=1.771958, (0 missing)
##       temperature       < 7.85   to the right, improve=1.464489, (0 missing)
##       DMC               < 81.35  to the left,  improve=1.418259, (0 missing)
##       wind speeds       < 4.25   to the right, improve=1.381895, (0 missing)
##   Surrogate splits:
##       DC < 29.25  to the left,  agree=0.766, adj=0.071, (0 split)
##
## Node number 9: 46 observations,    complexity param=0.01546392
##   predicted class=1  expected loss=0.3913043  P(node) =0.1111111
##     class counts:    18    28
##    probabilities: 0.391 0.609
##   left son=18 (9 obs) right son=19 (37 obs)
##   Primary splits:
##       ISI               < 6.4    to the left,  improve=1.6968270, (0 missing)
##       relative humidity < 53.5   to the right, improve=1.1801000, (0 missing)
##       DMC               < 192.65 to the right, improve=1.1130430, (0 missing)
##       DC                < 748.4  to the right, improve=0.6915381, (0 missing)
##       wind speeds       < 3.8    to the left,  improve=0.5899666, (0 missing)
##   Surrogate splits:
##       FFMC < 90.2   to the left,  agree=0.848, adj=0.222, (0 split)
##       DMC  < 87.1   to the left,  agree=0.848, adj=0.222, (0 split)
##       DC   < 736.9  to the left,  agree=0.848, adj=0.222, (0 split)
##
## Node number 14: 137 observations,    complexity param=0.01546392
##   predicted class=1  expected loss=0.3941606  P(node) =0.3309179
##     class counts:    54    83
##    probabilities: 0.394 0.606
##   left son=28 (65 obs) right son=29 (72 obs)
##   Primary splits:
##       FFMC              < 92.15  to the right, improve=2.382794, (0 missing)
##       relative humidity < 34.5   to the left,  improve=2.373746, (0 missing)
##       DMC               < 144.2  to the right, improve=1.934265, (0 missing)
##       wind speeds       < 3.8    to the left,  improve=1.892995, (0 missing)
##       DC                < 613.85 to the right, improve=1.660246, (0 missing)
##   Surrogate splits:
##       ISI               < 8.35   to the right, agree=0.803, adj=0.585, (0 split)
##       DMC               < 114.85 to the right, agree=0.628, adj=0.215, (0 split)
##       temperature       < 22     to the right, agree=0.628, adj=0.215, (0 split)
##       relative humidity < 32.5   to the left,  agree=0.628, adj=0.215, (0 split)
##       wind speeds       < 3.8    to the right, agree=0.613, adj=0.185, (0 split)
##
## Node number 15: 36 observations
##   predicted class=1  expected loss=0.1944444  P(node) =0.08695652
##     class counts:     7    29
##    probabilities: 0.194 0.806
```

```
##
## Node number 16: 42 observations
##   predicted class=0  expected loss=0.2142857  P(node) =0.1014493
##     class counts:    33     9
##    probabilities: 0.786 0.214
##
## Node number 17: 125 observations,    complexity param=0.01202749
##   predicted class=0  expected loss=0.448  P(node) =0.3019324
##     class counts:    69    56
##    probabilities: 0.552 0.448
##   left son=34 (21 obs) right son=35 (104 obs)
##   Primary splits:
##       DMC               < 141.85 to the right, improve=2.2241830, (0 missing)
##       temperature       < 19.45  to the right, improve=1.3809010, (0 missing)
##       relative humidity < 84.5   to the right, improve=1.3809010, (0 missing)
##       FFMC              < 91.15  to the right, improve=1.1218720, (0 missing)
##       ISI               < 3.45   to the left,  improve=0.9318431, (0 missing)
##   Surrogate splits:
##       temperature < 19.45  to the right, agree=0.856, adj=0.143, (0 split)
##
## Node number 18: 9 observations
##   predicted class=0  expected loss=0.3333333  P(node) =0.02173913
##     class counts:     6     3
##    probabilities: 0.667 0.333
##
## Node number 19: 37 observations
##   predicted class=1  expected loss=0.3243243  P(node) =0.08937198
##     class counts:    12    25
##    probabilities: 0.324 0.676
##
## Node number 28: 65 observations,    complexity param=0.01546392
##   predicted class=1  expected loss=0.4923077  P(node) =0.1570048
##     class counts:    32    33
##    probabilities: 0.492 0.508
##   left son=56 (15 obs) right son=57 (50 obs)
##   Primary splits:
##       DMC         < 168.65 to the right, improve=3.692308, (0 missing)
##       DC          < 695.45 to the right, improve=2.862308, (0 missing)
##       FFMC        < 92.45  to the left,  improve=1.954572, (0 missing)
##       temperature < 23.85  to the right, improve=1.886247, (0 missing)
##       ISI         < 14.9   to the left,  improve=1.728157, (0 missing)
##   Surrogate splits:
##       FFMC              < 96.05  to the right, agree=0.815, adj=0.200, (0 split)
##       relative humidity < 47.5   to the right, agree=0.815, adj=0.200, (0 split)
##       rain amount       < 0.2    to the right, agree=0.800, adj=0.133, (0 split)
##       temperature       < 25.75  to the right, agree=0.785, adj=0.067, (0 split)
##
## Node number 29: 72 observations
##   predicted class=1  expected loss=0.3055556  P(node) =0.173913
##     class counts:    22    50
##    probabilities: 0.306 0.694
##
## Node number 34: 21 observations
##   predicted class=0  expected loss=0.2380952  P(node) =0.05072464
```

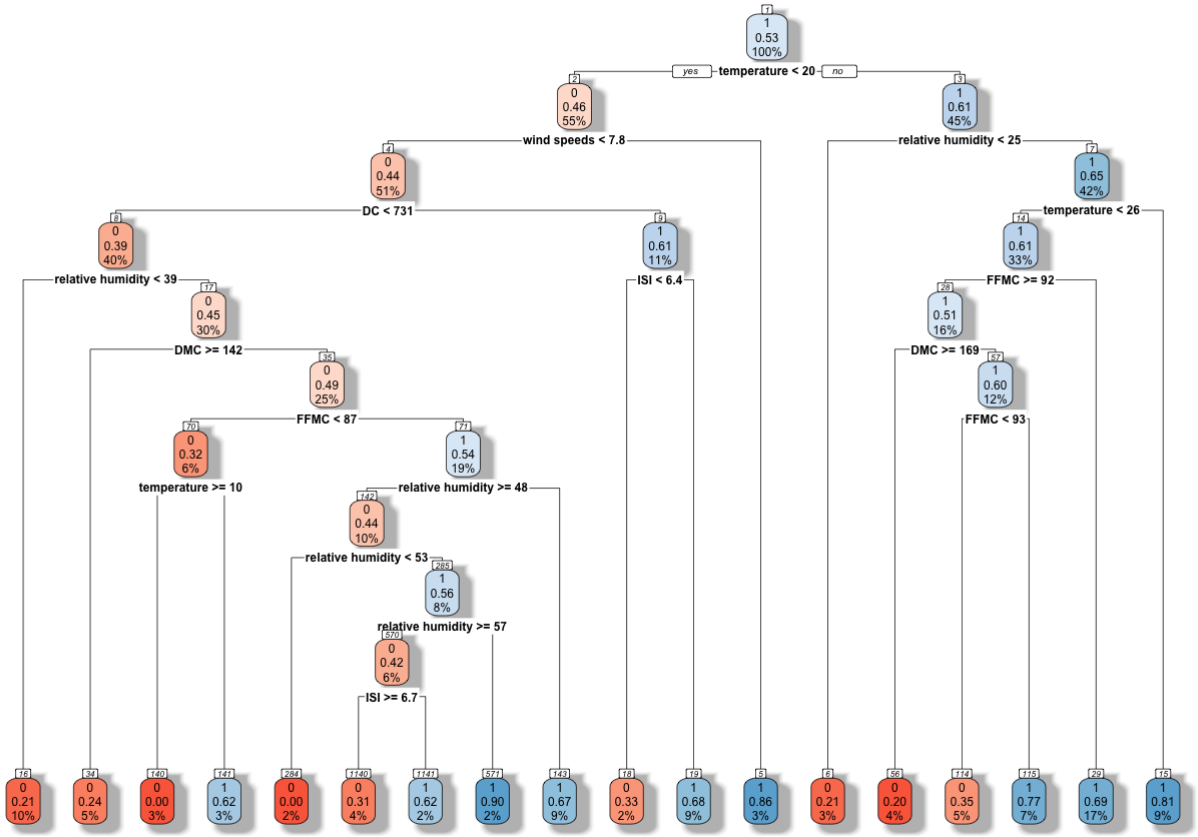
```
##     class counts:    16     5
##    probabilities: 0.762 0.238
##
## Node number 35: 104 observations,    complexity param=0.01202749
##   predicted class=0  expected loss=0.4903846  P(node) =0.2512077
##     class counts:    53    51
##    probabilities: 0.510 0.490
##   left son=70 (25 obs) right son=71 (79 obs)
##   Primary splits:
##       FFMC              < 86.7   to the left,  improve=1.910896, (0 missing)
##       relative humidity < 41.5   to the right, improve=1.828595, (0 missing)
##       DMC               < 8.45   to the left,  improve=1.812875, (0 missing)
##       ISI               < 3.45   to the left,  improve=1.565624, (0 missing)
##       temperature       < 16     to the left,  improve=1.538490, (0 missing)
##   Surrogate splits:
##       ISI         < 3.6    to the left,  agree=0.942, adj=0.76, (0 split)
##       DMC         < 33.05  to the left,  agree=0.894, adj=0.56, (0 split)
##       temperature < 8.25   to the left,  agree=0.856, adj=0.40, (0 split)
##       DC          < 61.5   to the left,  agree=0.837, adj=0.32, (0 split)
##
## Node number 56: 15 observations
##   predicted class=0  expected loss=0.2  P(node) =0.03623188
##     class counts:    12     3
##    probabilities: 0.800 0.200
##
## Node number 57: 50 observations,    complexity param=0.01546392
##   predicted class=1  expected loss=0.4  P(node) =0.1207729
##     class counts:    20    30
##    probabilities: 0.400 0.600
##   left son=114 (20 obs) right son=115 (30 obs)
##   Primary splits:
##       FFMC              < 92.85  to the left,  improve=4.166667, (0 missing)
##       ISI               < 9      to the left,  improve=3.841270, (0 missing)
##       DC                < 717.5  to the right, improve=3.020979, (0 missing)
##       DMC               < 121.4  to the left,  improve=1.500000, (0 missing)
##       relative humidity < 32.5   to the left,  improve=1.500000, (0 missing)
##   Surrogate splits:
##       ISI               < 9      to the left,  agree=0.80, adj=0.50, (0 split)
##       DC                < 740.05 to the right, agree=0.78, adj=0.45, (0 split)
##       DMC               < 121.4  to the left,  agree=0.76, adj=0.40, (0 split)
##       relative humidity < 30     to the left,  agree=0.76, adj=0.40, (0 split)
##       temperature       < 21.65  to the left,  agree=0.64, adj=0.10, (0 split)
##
## Node number 70: 25 observations,    complexity param=0.01202749
##   predicted class=0  expected loss=0.32  P(node) =0.06038647
##     class counts:    17     8
##    probabilities: 0.680 0.320
##   left son=140 (12 obs) right son=141 (13 obs)
##   Primary splits:
##       temperature       < 10.35  to the right, improve=4.7261540, (0 missing)
##       relative humidity < 52.5   to the left,  improve=4.7261540, (0 missing)
##       wind speeds       < 4.25   to the left,  improve=1.9968830, (0 missing)
##       DMC               < 18.85  to the right, improve=0.7501299, (0 missing)
##       DC                < 72.75  to the right, improve=0.7501299, (0 missing)
```

```
##   Surrogate splits:
##       relative humidity < 49.5   to the left,  agree=0.80, adj=0.583, (0 split)
##       DMC               < 30.15  to the right, agree=0.68, adj=0.333, (0 split)
##       wind speeds       < 3.55   to the left,  agree=0.68, adj=0.333, (0 split)
##       DC                < 508.85 to the right, agree=0.64, adj=0.250, (0 split)
##       FFMC              < 71.65  to the left,  agree=0.60, adj=0.167, (0 split)
##
## Node number 71: 79 observations,    complexity param=0.01202749
##   predicted class=1  expected loss=0.4556962  P(node) =0.1908213
##     class counts:    36    43
##    probabilities: 0.456 0.544
##   left son=142 (43 obs) right son=143 (36 obs)
##   Primary splits:
##       relative humidity < 47.5   to the right, improve=1.9805710, (0 missing)
##       DC                < 100.55 to the right, improve=0.9832800, (0 missing)
##       temperature       < 16     to the left,  improve=0.9548085, (0 missing)
##       wind speeds       < 4.25   to the right, improve=0.8767014, (0 missing)
##       DMC               < 128    to the left,  improve=0.5550908, (0 missing)
##   Surrogate splits:
##       DC          < 674.1  to the right, agree=0.608, adj=0.139, (0 split)
##       temperature < 18.3   to the left,  agree=0.608, adj=0.139, (0 split)
##       FFMC        < 87.75  to the right, agree=0.582, adj=0.083, (0 split)
##       ISI         < 9.55   to the left,  agree=0.582, adj=0.083, (0 split)
##       wind speeds < 1.1    to the right, agree=0.582, adj=0.083, (0 split)
##
## Node number 114: 20 observations
##   predicted class=0  expected loss=0.35  P(node) =0.04830918
##     class counts:    13     7
##    probabilities: 0.650 0.350
##
## Node number 115: 30 observations
##   predicted class=1  expected loss=0.2333333  P(node) =0.07246377
##     class counts:     7    23
##    probabilities: 0.233 0.767
##
## Node number 140: 12 observations
##   predicted class=0  expected loss=0  P(node) =0.02898551
##     class counts:    12     0
##    probabilities: 1.000 0.000
##
## Node number 141: 13 observations
##   predicted class=1  expected loss=0.3846154  P(node) =0.03140097
##     class counts:     5     8
##    probabilities: 0.385 0.615
##
## Node number 142: 43 observations,    complexity param=0.01202749
##   predicted class=0  expected loss=0.4418605  P(node) =0.1038647
##     class counts:    24    19
##    probabilities: 0.558 0.442
##   left son=284 (9 obs) right son=285 (34 obs)
##   Primary splits:
##       relative humidity < 52.5   to the left,  improve=4.4445960, (0 missing)
##       FFMC              < 90.8   to the right, improve=2.0015100, (0 missing)
##       ISI               < 5.6    to the right, improve=1.8664450, (0 missing)
```

```
##       DMC              < 104.65 to the right, improve=1.0122580, (0 missing)
##       DC               < 639.15 to the right, improve=0.9668781, (0 missing)
##   Surrogate splits:
##       temperature < 18.4   to the right, agree=0.837, adj=0.222, (0 split)
##       DMC         < 21.9   to the left,  agree=0.814, adj=0.111, (0 split)
##       DC          < 45.9   to the left,  agree=0.814, adj=0.111, (0 split)
##
## Node number 143: 36 observations
##   predicted class=1  expected loss=0.3333333  P(node) =0.08695652
##     class counts:    12    24
##    probabilities: 0.333 0.667
##
## Node number 284: 9 observations
##   predicted class=0  expected loss=0  P(node) =0.02173913
##     class counts:     9     0
##    probabilities: 1.000 0.000
##
## Node number 285: 34 observations,    complexity param=0.01202749
##   predicted class=1  expected loss=0.4411765  P(node) =0.0821256
##     class counts:    15    19
##    probabilities: 0.441 0.559
##   left son=570 (24 obs) right son=571 (10 obs)
##   Primary splits:
##       relative humidity < 57     to the right, improve=3.2980390, (0 missing)
##       ISI               < 6      to the right, improve=2.0916290, (0 missing)
##       DMC               < 104.65 to the right, improve=1.2390140, (0 missing)
##       FFMC              < 90.25  to the right, improve=1.0008170, (0 missing)
##       temperature       < 17.55  to the left,  improve=0.7647059, (0 missing)
##   Surrogate splits:
##       FFMC < 94.15  to the left,  agree=0.735, adj=0.1, (0 split)
##       DC   < 712.1  to the left,  agree=0.735, adj=0.1, (0 split)
##       ISI  < 15.85  to the left,  agree=0.735, adj=0.1, (0 split)
##
## Node number 570: 24 observations,    complexity param=0.01030928
##   predicted class=0  expected loss=0.4166667  P(node) =0.05797101
##     class counts:    14    10
##    probabilities: 0.583 0.417
##   left son=1140 (16 obs) right son=1141 (8 obs)
##   Primary splits:
##       ISI         < 6.65   to the right, improve=1.0416670, (0 missing)
##       temperature < 14.9   to the left,  improve=0.6736597, (0 missing)
##       DMC         < 104.65 to the right, improve=0.6666667, (0 missing)
##       DC          < 683.6  to the right, improve=0.6666667, (0 missing)
##       FFMC        < 89.9   to the right, improve=0.4733894, (0 missing)
##   Surrogate splits:
##       FFMC        < 88.4   to the right, agree=0.792, adj=0.375, (0 split)
##       DMC         < 90.9   to the right, agree=0.750, adj=0.250, (0 split)
##       DC          < 720.05 to the left,  agree=0.750, adj=0.250, (0 split)
##       temperature < 11.05  to the right, agree=0.708, adj=0.125, (0 split)
##
## Node number 571: 10 observations
##   predicted class=1  expected loss=0.1  P(node) =0.02415459
##     class counts:     1     9
##    probabilities: 0.100 0.900
```

```
##
## Node number 1140: 16 observations
##   predicted class=0  expected loss=0.3125  P(node) =0.03864734
##     class counts:    11     5
##    probabilities: 0.688 0.312
##
## Node number 1141: 8 observations
##   predicted class=1  expected loss=0.375  P(node) =0.01932367
##     class counts:     3     5
##    probabilities: 0.375 0.625
```

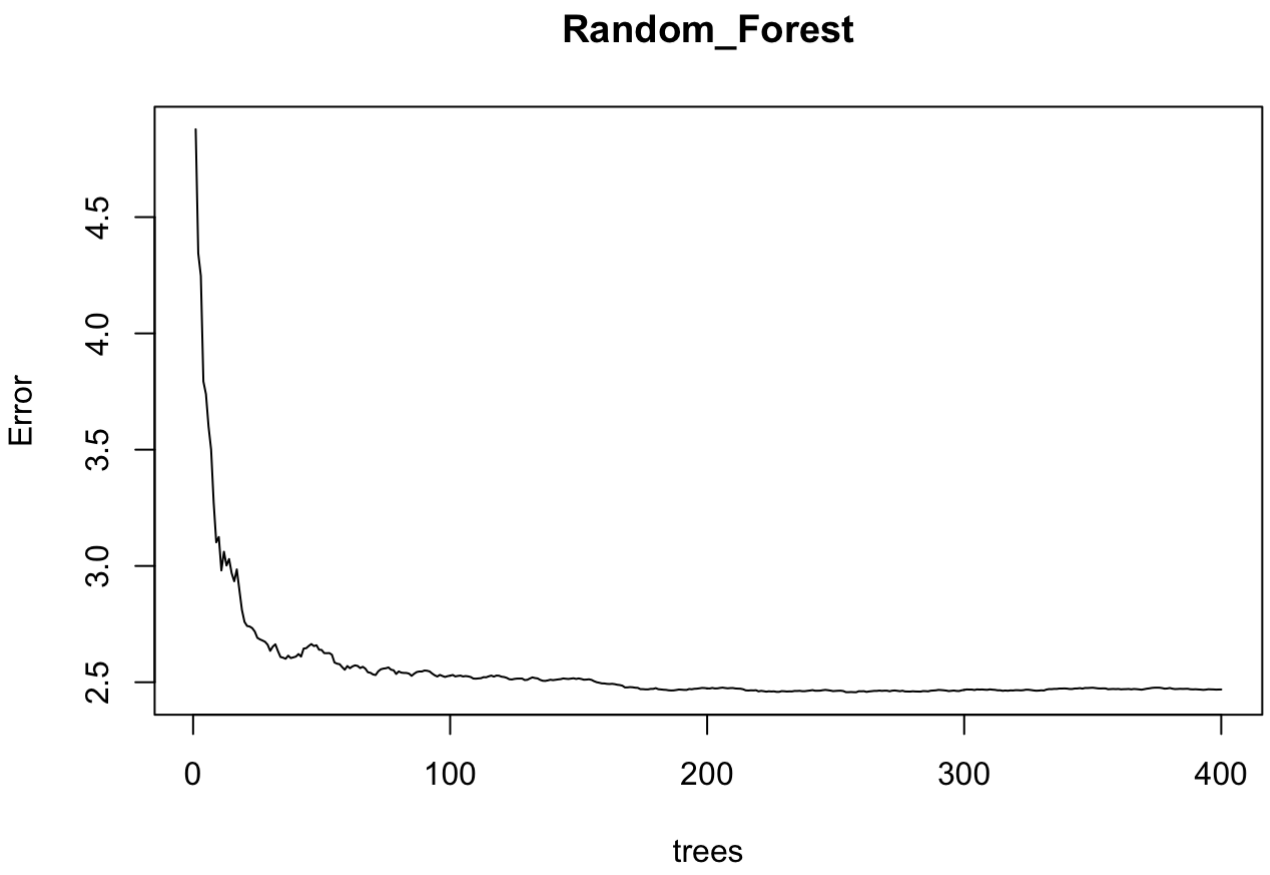
```
rpart.plot(dt, box.palette="RdBu", shadow.col="gray", nn=TRUE)
```




```
#### Random Forest
traindata2 <- dplyr::select(traindata,(1:9))
testdata2 <- testdata
colnames(traindata2) <- c("FFMC","DMC","DC", "ISI","Temp","Rel_Hum","Wind_Speed","Rain_A
mt","Y/N")
colnames(testdata2) <- c("FFMC","DMC","DC", "ISI","Temp","Rel_Hum","Wind_Speed","Rain_Am
t","Y/N")
traindata2$`Y/N` <- as.numeric(traindata2$`Y/N`)
traindata2 <- as.data.frame(traindata2)
Random_Forest <- randomForest(formula = traindata2$`Y/N` ~ .,data=traindata2,ntree = 400
, mtry = 6, importance = TRUE)
Random_Forest
```

```
##
## Call:
##  randomForest(formula = traindata2$`Y/N` ~ ., data = traindata2,      ntree = 400, mt
ry = 6, importance = TRUE)
##                Type of random forest: regression
##                      Number of trees: 400
## No. of variables tried at each split: 6
##
##           Mean of squared residuals: 2.468835
##                     % Var explained: 18.67
```

```
plot(Random_Forest)
```




```
gt <- getTree(Random_Forest, 5, labelVar=TRUE)
gt <- as.data.frame(gt)
summary(gt)
```

```
##  left daughter    right daughter        split var    split point
##  Min.   :  0.00   Min.   :  0.00   Temp      : 20   Min.   :  0.00
##  1st Qu.:  0.00   1st Qu.:  0.00   Rel_Hum   : 19   1st Qu.:  0.00
##  Median :  0.00   Median :  0.00   Wind_Speed: 19   Median :  0.00
##  Mean   : 58.75   Mean   : 59.25   ISI       : 18   Mean   : 57.10
##  3rd Qu.:117.00   3rd Qu.:118.00   Rain_Amt  : 15   3rd Qu.: 29.65
##  Max.   :234.00   Max.   :235.00   (Other)   : 26   Max.   :811.65
##                                    NA's      :118
##      status         prediction
##  Min.   :-3.000   Min.   :0.900
##  1st Qu.:-3.000   1st Qu.:2.836
##  Median :-1.000   Median :4.000
##  Mean   :-1.996   Mean   :4.042
##  3rd Qu.:-1.000   3rd Qu.:4.940
##  Max.   :-1.000   Max.   :9.400
##
```

```
y_pred = predict(Random_Forest, newdata = testdata2[,-9])
rfp <- as.data.frame(y_pred)
rfp$y_pred <- as.factor(rfp$y_pred)
rfa <- as.data.frame(testdata2[,9])
rfa$`Y/N` <- as.factor(rfa$`Y/N`)
length(rfa$`Y/N`)
```

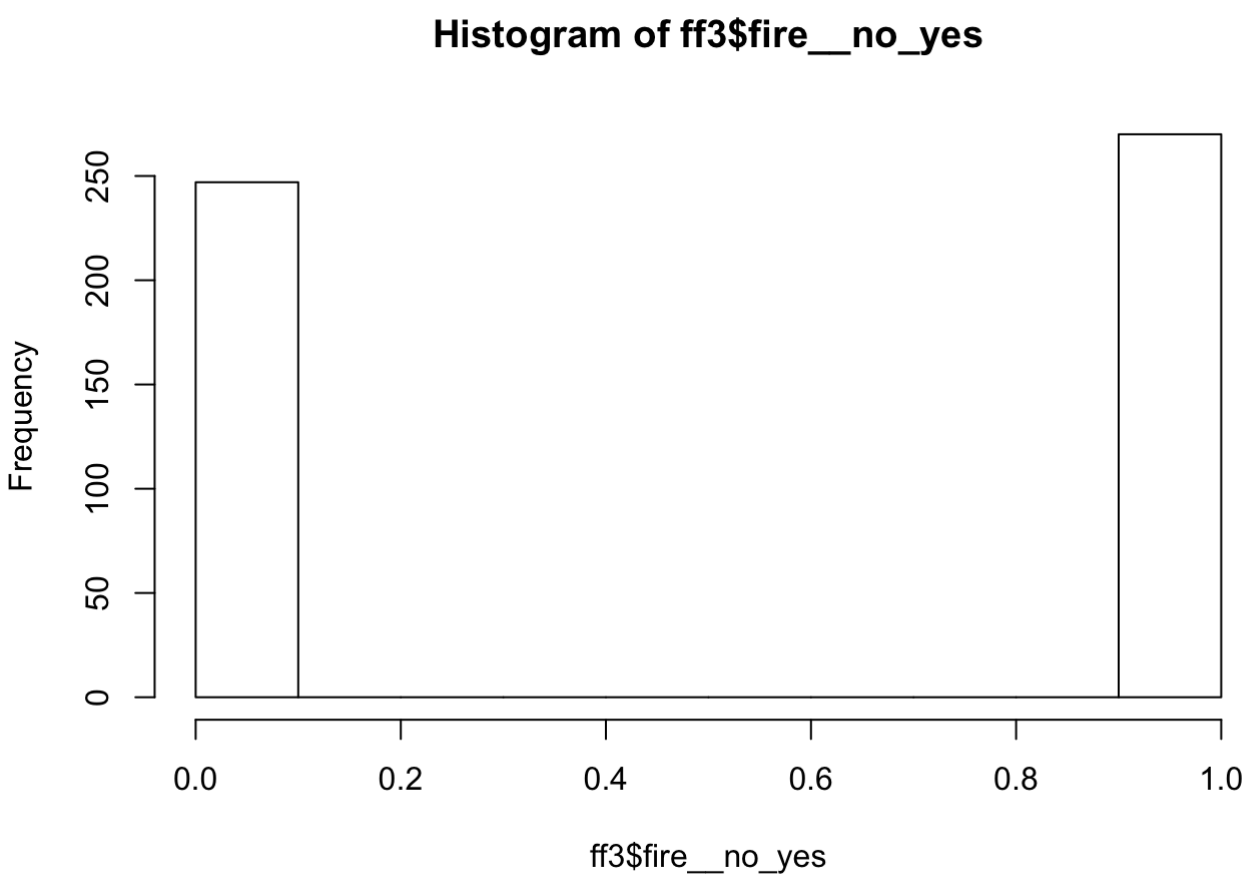
```
## [1] 171
```

```
length(rfp$y_pred)
```

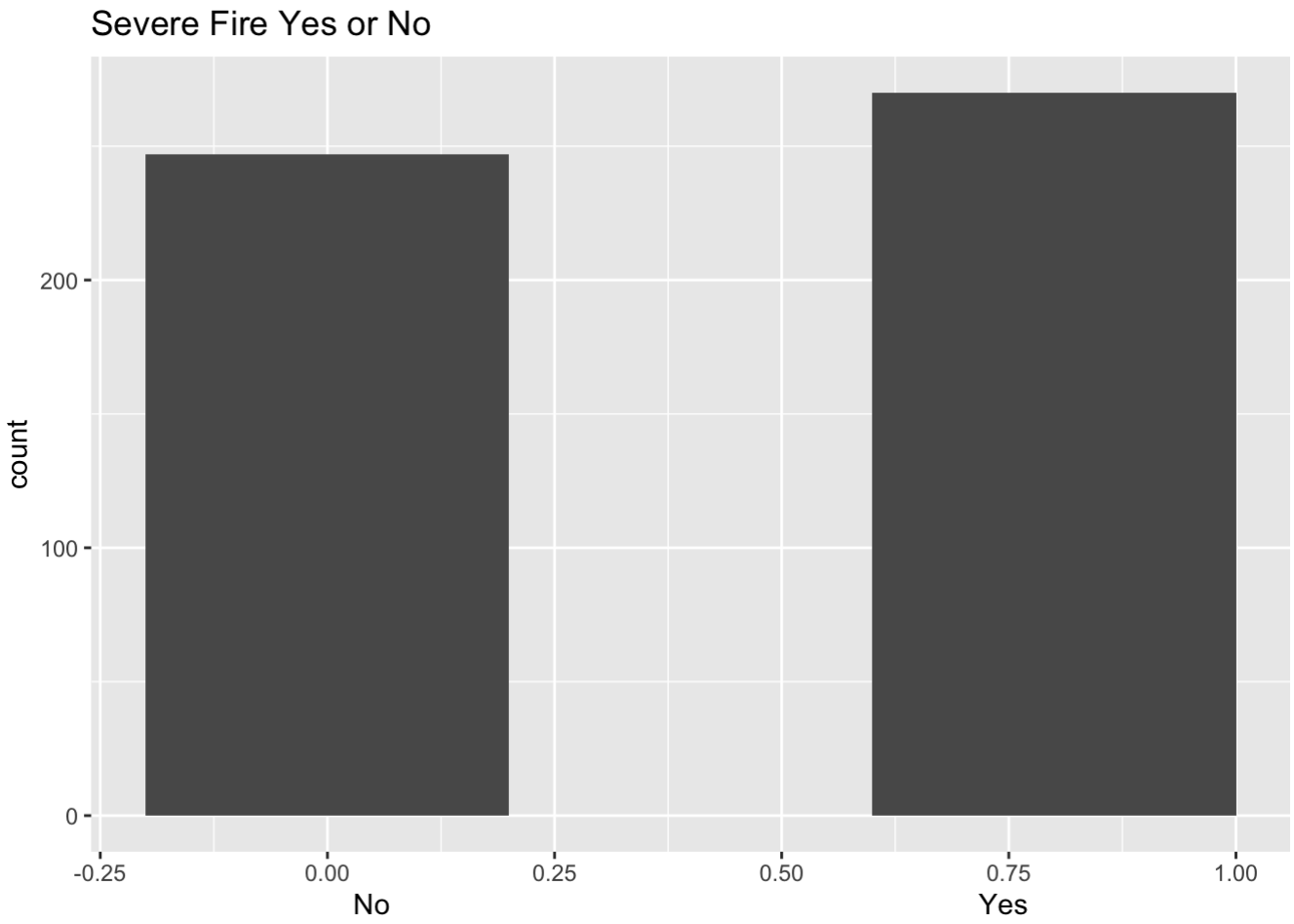
```
## [1] 171
```

```
rfa$`Y/N` <- as.factor(rfa$`Y/N`)
rfp$y_pred <- as.factor(rfp$y_pred)
#confusionMatrix(rfp$y_pred, rfa$`Y/N`)


hist(ff3$fire__no_yes)
```




```
ggplot(ff3, aes(x=ff3$fire__no_yes)) + geom_histogram(binwidth=0.4) + labs(title = "Seve
re Fire Yes or No", x="No
Yes", y="count")
```




```
# Naive Bayes
ff <- ForestFiresWith
#ff <-as.data.frame(read.csv("C:/Users/tmacd/Downloads/fire.csv"))
#ff<-read.csv("C:/Users/tmacd/Downloads/fire.csv")
#ff <-as.data.frame(ff)

#fff<-ff %>% mutate_if(is.numeric,funs(as.factor))
#str(ff)

#corrplot(ff, method = "number")
#corrplot(corrgram(ff))

str(ff)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    517 obs. of  14 variables:
##  $ X               : num  7 2 2 3 5 6 6 3 2 6 ...
##  $ Y               : num  5 4 2 4 4 5 4 4 4 3 ...
##  $ month           : chr  "apr" "jan" "feb" "mar" ...
##  $ day             : chr  "sun" "sat" "sat" "sat" ...
##  $ FFMC            : num  81.9 82.1 79.5 69 85.2 75.1 75.1 86.9 93.4 91 ...
##  $ DMC             : num  3 3.7 3.6 2.4 4.9 4.4 4.4 6.6 15 14.6 ...
##  $ DC              : num  7.9 9.3 15.3 15.5 15.8 16.2 16.2 18.7 25.6 25.6 ...
##  $ ISI             : num  3.5 2.9 1.8 0.7 6.3 1.9 1.9 3.2 11.4 12.3 ...
##  $ temperature     : num  13.4 5.3 4.6 17.4 7.5 4.6 5.1 8.8 15.2 13.7 ...
##  $ relative humidity: num  75 78 59 24 46 82 77 35 19 33 ...
##  $ wind speeds     : num  1.8 3.1 0.9 5.4 8 6.3 5.4 3.1 7.6 9.4 ...
##  $ rain amount     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ area            : num  0 0 6.84 0 24.24 ...
##  $ fire__no_yes    : num  0 0 1 0 1 1 1 1 0 1 ...
```

```
ff$month <- as.factor(ff$month)
ff$day <- as.factor(ff$day)
ff$fire__no_yes <- as.factor(ff$fire__no_yes)

ff <- japply( ff, which(sapply(ff, class)=="integer"), as.numeric )
str(ff)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    517 obs. of  14 variables:
##  $ X               : num  7 2 2 3 5 6 6 3 2 6 ...
##  $ Y               : num  5 4 2 4 4 5 4 4 4 3 ...
##  $ month           : Factor w/ 12 levels "apr","aug","dec",..: 1 5 4 8 4 4 4 4 8 1
...
##  $ day             : Factor w/ 7 levels "fri","mon","sat",..: 4 3 3 3 1 6 6 7 6 4
...
##  $ FFMC            : num  81.9 82.1 79.5 69 85.2 75.1 75.1 86.9 93.4 91 ...
##  $ DMC             : num  3 3.7 3.6 2.4 4.9 4.4 4.4 6.6 15 14.6 ...
##  $ DC              : num  7.9 9.3 15.3 15.5 15.8 16.2 16.2 18.7 25.6 25.6 ...
##  $ ISI             : num  3.5 2.9 1.8 0.7 6.3 1.9 1.9 3.2 11.4 12.3 ...
##  $ temperature     : num  13.4 5.3 4.6 17.4 7.5 4.6 5.1 8.8 15.2 13.7 ...
##  $ relative humidity: num  75 78 59 24 46 82 77 35 19 33 ...
##  $ wind speeds     : num  1.8 3.1 0.9 5.4 8 6.3 5.4 3.1 7.6 9.4 ...
##  $ rain amount     : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ area            : num  0 0 6.84 0 24.24 ...
##  $ fire__no_yes    : Factor w/ 2 levels "0","1": 1 1 2 1 2 2 2 2 1 2 ...
```

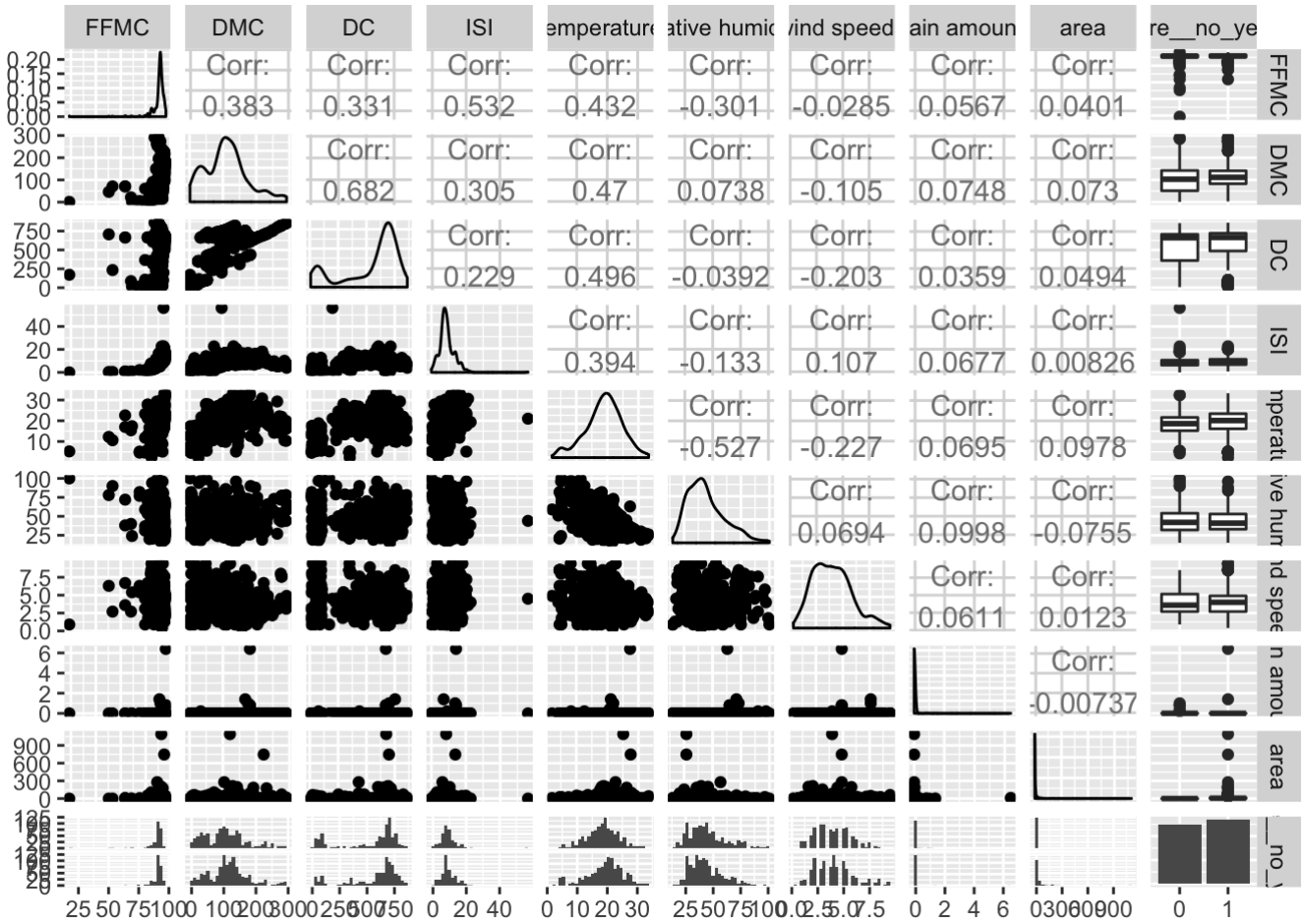
```
numff<-ff[,-c(1,2,3,4)]
str(numff)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    517 obs. of  10 variables:
##  $ FFMC             : num  81.9 82.1 79.5 69 85.2 75.1 75.1 86.9 93.4 91 ...
##  $ DMC              : num  3 3.7 3.6 2.4 4.9 4.4 4.4 6.6 15 14.6 ...
##  $ DC               : num  7.9 9.3 15.3 15.5 15.8 16.2 16.2 18.7 25.6 25.6 ...
##  $ ISI              : num  3.5 2.9 1.8 0.7 6.3 1.9 1.9 3.2 11.4 12.3 ...
##  $ temperature      : num  13.4 5.3 4.6 17.4 7.5 4.6 5.1 8.8 15.2 13.7 ...
##  $ relative humidity: num  75 78 59 24 46 82 77 35 19 33 ...
##  $ wind speeds      : num  1.8 3.1 0.9 5.4 8 6.3 5.4 3.1 7.6 9.4 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ area             : num  0 0 6.84 0 24.24 ...
##  $ fire__no_yes     : Factor w/ 2 levels "0","1": 1 1 2 1 2 2 2 2 1 2 ...
```

```
ggpairs(numff)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
#testdata$fire__no_yes <- as.factor(testdata$fire__no_yes)

x<-traindata[ , -which(names(traindata) %in% c("fire__no_yes"))]
str(x)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    346 obs. of  10 variables:
##  $ X                : num  0.693 1.386 1.099 1.099 1.792 ...
##  $ Y                : num  2 3 4 5 5 6 4 4 4 4 ...
##  $ FFMC             : num  84 90.3 91.8 93.5 87.1 91.1 91.9 91.7 91.5 92.1 ...
##  $ DMC              : num  9.3 290 170.9 139.4 291.3 ...
##  $ DC               : num  34 855 692 594 861 ...
##  $ ISI              : num  2.1 7.4 13.7 20.3 4 5.8 8 7.8 10.7 9.6 ...
##  $ temperature      : num  13.9 19.9 20.6 17.6 17 23.4 21.4 17 17.1 17.4 ...
##  $ relative humidity: num  40 44 59 52 67 22 38 27 43 57 ...
##  $ wind speeds      : num  5.4 3.1 0.9 5.8 4.9 2.7 2.7 4.9 5.4 4.5 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0 ...
```

```
y <- traindata[,"fire__no_yes"]
str(y)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    346 obs. of  1 variable:
##  $ fire__no_yes: num  0 1 0 0 1 0 1 1 0 0 ...
```

```
##remove "area" column.
ff <- ff[,-13]
#str(ff)
#sapply(ff, sd)
trainRatio <- .67
set.seed(1016) # Set Seed so that same sample can be reproduced in future also
sample <- sample.int(n = nrow(ff), size = floor(trainRatio*nrow(ff)), replace = FALSE)
testdata <- ff[-sample, ]
str(testdata)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    171 obs. of  13 variables:
##  $ X                : num  7 6 3 6 3 5 6 2 6 4 ...
##  $ Y                : num  5 5 4 3 4 5 5 2 5 5 ...
##  $ month            : Factor w/ 12 levels "apr","aug","dec",..: 1 4 4 1 4 8 8 4 8 4
...
##  $ day              : Factor w/ 7 levels "fri","mon","sat",..: 4 6 7 4 3 5 2 1 5 4
...
##  $ FFMC             : num  81.9 75.1 86.9 91 83.9 90.9 87.2 86.6 91.3 85 ...
##  $ DMC              : num  3 4.4 6.6 14.6 8 18.9 15.1 13.2 20.6 9 ...
##  $ DC               : num  7.9 16.2 18.7 25.6 30.2 30.6 36.9 43 43.5 56.9 ...
##  $ ISI              : num  3.5 1.9 3.2 12.3 2.6 8 7.1 5.3 8.5 3.5 ...
##  $ temperature      : num  13.4 4.6 8.8 13.7 12.7 11.6 10.2 12.3 13.3 10.1 ...
##  $ relative humidity: num  75 82 35 33 48 48 45 51 27 62 ...
##  $ wind speeds      : num  1.8 6.3 3.1 9.4 1.8 5.4 5.8 0.9 3.6 1.8 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ fire__no_yes     : Factor w/ 2 levels "0","1": 1 2 2 2 1 1 2 1 2 2 ...
```

```
testdata <- testdata[, -c(1:4)]
summary(testdata)
```

```
##       FFMC            DMC               DC             ISI
##  Min.   :50.40   Min.   :  3.00   Min.   :  7.9   Min.   : 0.400
##  1st Qu.:90.10   1st Qu.: 51.75   1st Qu.:399.9   1st Qu.: 6.700
##  Median :91.60   Median : 97.90   Median :664.5   Median : 8.400
##  Mean   :90.48   Mean   :100.55   Mean   :536.5   Mean   : 8.763
##  3rd Qu.:92.50   3rd Qu.:130.90   3rd Qu.:713.5   3rd Qu.:10.100
##  Max.   :96.10   Max.   :276.30   Max.   :825.1   Max.   :22.600
##   temperature    relative humidity  wind speeds     rain amount
##  Min.   : 4.60   Min.   :17.00     Min.   :0.900   Min.   :0.00000
##  1st Qu.:14.65   1st Qu.:32.50     1st Qu.:2.700   1st Qu.:0.00000
##  Median :18.70   Median :41.00     Median :4.000   Median :0.00000
##  Mean   :18.18   Mean   :44.82     Mean   :4.029   Mean   :0.01287
##  3rd Qu.:21.85   3rd Qu.:54.00     3rd Qu.:5.400   3rd Qu.:0.00000
##  Max.   :30.60   Max.   :99.00     Max.   :9.400   Max.   :1.40000
##  fire__no_yes
##  0:80
##  1:91
##
##
##
##
```

```
traindata <- ff[sample, ]
traindata <- traindata[, -c(1:4)]
summary(traindata)
```

```
##       FFMC             DMC               DC             ISI
##  Min.   :18.70   Min.   :  1.10   Min.   :  9.3   Min.   : 0.00
##  1st Qu.:90.30   1st Qu.: 80.75   1st Qu.:474.9   1st Qu.: 6.30
##  Median :91.70   Median :111.70   Median :661.8   Median : 8.40
##  Mean   :90.73   Mean   :115.97   Mean   :553.6   Mean   : 9.15
##  3rd Qu.:93.10   3rd Qu.:146.97   3rd Qu.:713.9   3rd Qu.:11.30
##  Max.   :96.20   Max.   :291.30   Max.   :860.6   Max.   :56.10
##   temperature    relative humidity  wind speeds     rain amount
##  Min.   : 2.20   Min.   : 15.00    Min.   :0.400   Min.   :0.00000
##  1st Qu.:16.10   1st Qu.: 33.00    1st Qu.:2.700   1st Qu.:0.00000
##  Median :19.60   Median : 42.00    Median :4.000   Median :0.00000
##  Mean   :19.24   Mean   : 44.03    Mean   :4.012   Mean   :0.02601
##  3rd Qu.:23.30   3rd Qu.: 53.00    3rd Qu.:4.900   3rd Qu.:0.00000
##  Max.   :33.30   Max.   :100.00    Max.   :9.400   Max.   :6.40000
##  fire__no_yes
##  0:167
##  1:179
##
##
##
##
```

```
#View(traindata)

traindata2 <- traindata
colnames(traindata2) <- c("FFMC","DMC","DC", "ISI","Temp","Rel_Hum","Wind_Speed","Rain_A
mt","Y/N")
traindata2$`Y/N` <- as.factor(traindata2$`Y/N`)
traindata2 <- as.data.frame(traindata2)


train_naibayes <- naiveBayes(traindata2$`Y/N` ~., data=traindata2, na.action = na.pass)

str(traindata2)
```

```
## 'data.frame':    346 obs. of  9 variables:
##  $ FFMC      : num  84 90.3 91.8 93.5 87.1 91.1 91.9 91.7 91.5 92.1 ...
##  $ DMC       : num  9.3 290 170.9 139.4 291.3 ...
##  $ DC        : num  34 855 692 594 861 ...
##  $ ISI       : num  2.1 7.4 13.7 20.3 4 5.8 8 7.8 10.7 9.6 ...
##  $ Temp      : num  13.9 19.9 20.6 17.6 17 23.4 21.4 17 17.1 17.4 ...
##  $ Rel_Hum   : num  40 44 59 52 67 22 38 27 43 57 ...
##  $ Wind_Speed: num  5.4 3.1 0.9 5.8 4.9 2.7 2.7 4.9 5.4 4.5 ...
##  $ Rain_Amt  : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ Y/N       : Factor w/ 2 levels "0","1": 1 2 1 1 2 1 2 2 1 1 ...
```

```
#removing yes/no label to test
testdata2 <- testdata[,-9]

#Naive Bayes model Prediction
nb_Pred <- predict(train_naibayes,testdata2)
```

```
## Warning in predict.naiveBayes(train_naibayes, testdata2): Type mismatch
## between training and new data for variable 'Temp'. Did you use factors with
## numeric labels for training, and numeric values for new data?
```

```
## Warning in predict.naiveBayes(train_naibayes, testdata2): Type mismatch
## between training and new data for variable 'Rel_Hum'. Did you use factors
## with numeric labels for training, and numeric values for new data?
```

```
## Warning in predict.naiveBayes(train_naibayes, testdata2): Type mismatch
## between training and new data for variable 'Wind_Speed'. Did you use
## factors with numeric labels for training, and numeric values for new data?
```

```
## Warning in predict.naiveBayes(train_naibayes, testdata2): Type mismatch
## between training and new data for variable 'Rain_Amt'. Did you use factors
## with numeric labels for training, and numeric values for new data?
```

```
nb_Pred
```

```
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 1 1 0 0 0 0 0 1 1 1
##  [36] 1 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1
##  [71] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 1 1
## [106] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1
## [141] 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 1 1 1 1 1 1
## Levels: 0 1
```

```
testsdata2 <- testdata[,-9]

#Testing accurancy of naive bayes model with Kaggle train data sub set
(confusionMatrix(nb_Pred, testdata$fire__no_yes))
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 18 22
##          1 62 69
##
##                Accuracy : 0.5088
##                  95% CI : (0.4313, 0.5859)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.755
##
##                   Kappa : -0.0173
##
##  Mcnemar's Test P-Value : 2.088e-05
##
##             Sensitivity : 0.2250
##             Specificity : 0.7582
##          Pos Pred Value : 0.4500
##          Neg Pred Value : 0.5267
##              Prevalence : 0.4678
##          Detection Rate : 0.1053
##    Detection Prevalence : 0.2339
##       Balanced Accuracy : 0.4916
##
##        'Positive' Class : 0
##
```

```
#Plot Variable performance
# X <- varImp(train_naibayes)
# X
# plot(X) <-sapply(y,as.factor)
y <- as.factor(y$fire__no_yes)

#model = train(x,y,'nb',trControl=trainControl(method='cv',number=10))
train_naibayes <- naiveBayes(traindata2$`Y/N` ~., data=traindata2, na.action = na.pass)
train_naibayes
```

```
##
## Naive Bayes Classifier for Discrete Predictors
##
## Call:
## naiveBayes.default(x = X, y = Y, laplace = laplace)
##
## A-priori probabilities:
## Y
##        0        1
## 0.482659 0.517341
##
## Conditional probabilities:
##    FFMC
## Y       [,1]     [,2]
##   0 90.05269 7.482170
##   1 91.35251 3.311494
##
##    DMC
## Y       [,1]     [,2]
##   0 109.5365 68.60180
##   1 121.9804 63.42465
##
##    DC
## Y       [,1]     [,2]
##   0 523.6629 263.3780
##   1 581.5609 226.7034
##
##    ISI
## Y       [,1]     [,2]
##   0 8.859281 5.523784
##   1 9.420670 4.140872
##
##    Temp
## Y       [,1]     [,2]
##   0 18.62515 5.596134
##   1 19.81676 6.288258
##
##    Rel_Hum
## Y       [,1]     [,2]
##   0 45.19760 17.54177
##   1 42.93296 14.96010
##
##    Wind_Speed
## Y       [,1]     [,2]
##   0 3.958084 1.581875
##   1 4.062011 1.887305
##
##    Rain_Amt
## Y         [,1]      [,2]
##   0 0.01556886 0.1052685
##   1 0.03575419 0.4783585
```

```
# str(model)

#Model Evaluation
#Predict testing set
Predict <- predict(train_naibayes,newdata = testdata )
```

```
## Warning in predict.naiveBayes(train_naibayes, newdata = testdata): Type
## mismatch between training and new data for variable 'Temp'. Did you use
## factors with numeric labels for training, and numeric values for new data?
```

```
## Warning in predict.naiveBayes(train_naibayes, newdata = testdata): Type
## mismatch between training and new data for variable 'Rel_Hum'. Did you use
## factors with numeric labels for training, and numeric values for new data?
```

```
## Warning in predict.naiveBayes(train_naibayes, newdata = testdata): Type
## mismatch between training and new data for variable 'Wind_Speed'. Did you
## use factors with numeric labels for training, and numeric values for new
## data?
```

```
## Warning in predict.naiveBayes(train_naibayes, newdata = testdata): Type
## mismatch between training and new data for variable 'Rain_Amt'. Did you use
## factors with numeric labels for training, and numeric values for new data?
```

```
#Get the confusion matrix to see accuracy value and other parameter values
Predict
```

```
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 1 1 0 0 0 0 0 1 1 1
##  [36] 1 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1
##  [71] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 0 1 1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 1 1
## [106] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1
## [141] 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 1 1 1 1 1 1 1 1 1 1
## Levels: 0 1
```

```
confusionMatrix(Predict, testdata$fire__no_yes )
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  0  1
##          0 18 22
##          1 62 69
##
##                Accuracy : 0.5088
##                  95% CI : (0.4313, 0.5859)
##     No Information Rate : 0.5322
##     P-Value [Acc > NIR] : 0.755
##
##                   Kappa : -0.0173
##
##  Mcnemar's Test P-Value : 2.088e-05
##
##             Sensitivity : 0.2250
##             Specificity : 0.7582
##          Pos Pred Value : 0.4500
##          Neg Pred Value : 0.5267
##              Prevalence : 0.4678
##          Detection Rate : 0.1053
##    Detection Prevalence : 0.2339
##       Balanced Accuracy : 0.4916
##
##        'Positive' Class : 0
##
```

```
str(ff6)
```

```
## 'data.frame':    414 obs. of  9 variables:
##  $ FFMC             : num  88.8 91 92.8 88.2 84.6 90.3 75.1 91.7 92.1 91.2 ...
##  $ DMC              : num  147.3 129.5 73.2 55.2 26.4 ...
##  $ DC               : num  614 693 713 732 352 ...
##  $ ISI              : num  9 7 22.6 11.6 2 7.4 1.9 11.1 9.6 12.5 ...
##  $ temperature      : num  14.4 18.8 19.3 15.2 5.1 19.9 4.6 16.8 16.6 12.6 ...
##  $ relative humidity: num  66 40 38 64 61 44 82 45 47 90 ...
##  $ wind speeds      : num  5.4 2.2 4 3.1 4.9 3.1 6.3 4.5 0.9 7.6 ...
##  $ rain amount      : num  0 0 0 0 0 0 0 0 0 0.2 ...
##  $ fire__no_yes     : num  0 1 0 1 1 1 1 1 1 0 ...
```

```
ff6$fire__no_yes <-  as.factor(ff6$fire__no_yes)
IG.CORElearn <- attrEval(ff6$fire__no_yes ~ ., data=ff6,  estimator = "InfGain")
IG.RWeka     <- InfoGainAttributeEval(Species ~ ., data=iris,)
IG.FSelector <- information.gain(Species ~ ., data=iris,)
IG.CORElearn
```

```
##             FFMC              DMC               DC              ISI
##      0.009286285      0.012383127      0.012410011      0.010643077
##      temperature relative humidity      wind speeds      rain amount
##      0.016756744      0.013328263      0.015651330      0.003070871
```