

Bike Sharing Data Exploration

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
#library(stats)

hour_2013 <- read.csv(file="D:/Capston/2013_Hour_By_Tract.csv", header=TRUE,
                      sep=";",
                      stringsAsFactors = FALSE)

hour_2013$dteday <- as.Date(hour_2013$dteday)
hour_2013$mday <- as.integer(format(hour_2013$dteday, "%d"))

hour_2013 <- subset(hour_2013, select = -c(yr, atemp))

str(hour_2013)

## 'data.frame': 399458 obs. of 17 variables:
## $ dteday : Date, format: "2013-01-01" "2013-01-01" ...
## $ tractID : int 2 8 16 17 19 21 29 30 32 36 ...
## $ jday : int 1 1 1 1 1 1 1 1 1 1 ...
## $ season : int 1 1 1 1 1 1 1 1 1 1 ...
## $ mth : int 1 1 1 1 1 1 1 1 1 1 ...
## $ hr : int 0 0 0 0 0 0 0 0 0 0 ...
## $ holiday : int 1 1 1 1 1 1 1 1 1 1 ...
## $ weekday : int 2 2 2 2 2 2 2 2 2 2 ...
## $ workingday: int 0 0 0 0 0 0 0 0 0 0 ...
## $ weather : int 2 2 2 2 2 2 2 2 2 2 ...
## $ temp : num 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 ...
## $ humidity : int 68 68 68 68 68 68 68 68 68 68 ...
## $ windspeed : num 11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 ...
## $ casual : int 0 0 0 0 0 0 1 2 0 0 ...
## $ registered: int 1 1 1 1 2 1 3 3 1 4 ...
## $ cnt : int 1 1 1 1 2 1 4 5 1 4 ...
## $ mday : int 1 1 1 1 1 1 1 1 1 1 ...

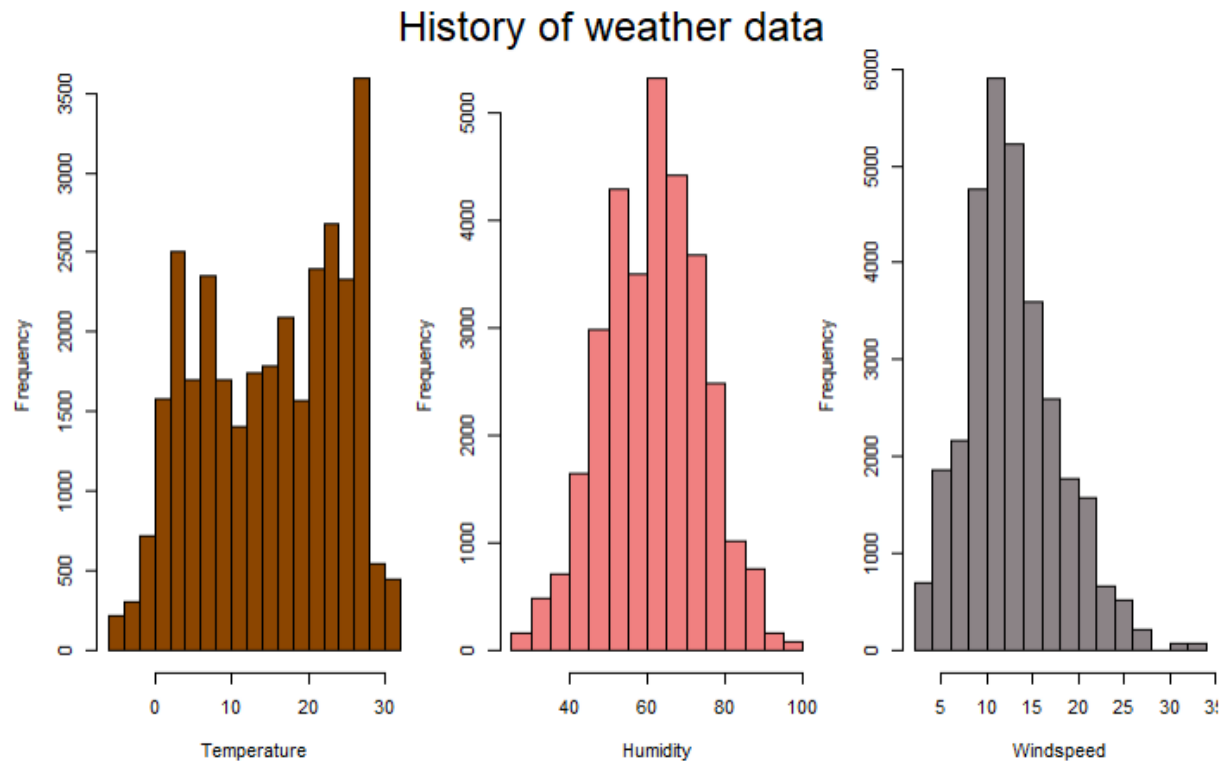
summary(hour_2013)

## dteday tractID jday season
## Min. :2013-01-01 Min. : 1.00 Min. : 1.0 Min. :1.000
## 1st Qu.:2013-04-19 1st Qu.: 25.00 1st Qu.:109.0 1st Qu.:2.000
```

```
## Median :2013-07-14    Median : 40.00    Median :195.0    Median :3.000
## Mean   :2013-07-09    Mean   : 44.47    Mean   :190.7    Mean   :2.596
## 3rd Qu.:2013-10-02    3rd Qu.: 67.00    3rd Qu.:275.0    3rd Qu.:4.000
## Max.   :2013-12-31    Max.   :113.00    Max.   :365.0    Max.   :4.000
##      mth             hr             holiday         weekday
## Min.   : 1.000      Min.   : 0.00      Min.   :0.00000    Min.   :0.000
## 1st Qu.: 4.000      1st Qu.: 9.00      1st Qu.:0.00000    1st Qu.:1.000
## Median : 7.000      Median :14.00     Median :0.00000    Median :3.000
## Mean   : 6.781      Mean   :13.22     Mean   :0.02707    Mean   :3.039
## 3rd Qu.:10.000     3rd Qu.:18.00     3rd Qu.:0.00000    3rd Qu.:5.000
## Max.   :12.000     Max.   :23.00     Max.   :1.00000    Max.   :6.000
##      workingday      weather         temp         humidity
## Min.   :0.0000      Min.   :1.000     Min.   : -8.90     Min.   : 12.0
## 1st Qu.:0.0000      1st Qu.:1.000     1st Qu.: 8.30     1st Qu.: 44.0
## Median :1.0000      Median :2.000     Median :17.20     Median : 58.0
## Mean   :0.6847      Mean   :1.702     Mean   :16.52     Mean   : 58.8
## 3rd Qu.:1.0000      3rd Qu.:2.000     3rd Qu.:24.40     3rd Qu.: 74.0
## Max.   :1.0000      Max.   :4.000     Max.   :35.00     Max.   :100.0
##      windspeed      casual      registered      cnt
## Min.   : 1.00      Min.   : 0.000     Min.   : 0.000     Min.   : 1.000
## 1st Qu.: 9.30      1st Qu.: 0.000     1st Qu.: 1.000     1st Qu.: 1.000
## Median :14.80      Median : 0.000     Median : 3.000     Median : 3.000
## Mean   :15.36      Mean   : 1.304     Mean   : 5.163     Mean   : 6.467
## 3rd Qu.:19.91      3rd Qu.: 1.000     3rd Qu.: 6.000     3rd Qu.: 7.000
## Max.   :53.70      Max.   :241.000     Max.   :169.000     Max.   :289.000
##      mday
## Min.   : 1.00
## 1st Qu.: 8.00
## Median :16.00
## Mean   :15.67
## 3rd Qu.:23.00
## Max.   :31.00
```

```
par(mfrow = c(1, 3), mar = c(4, 4, 2, 0))
```

```
hist(hour_2013$temp, col = "darkorange4", xlab = "Temperature", main = NULL)
hist(hour_2013$humidity, col = "lightcoral", xlab = "Humidity", main = NULL)
hist(hour_2013$windspeed, col = "lavenderblush4", xlab = "Windspeed", main =
NULL)
mtext("History of weather data", side = 3, line = -1.5, outer = TRUE, cex =
1.5)
```



```

hour_2013$tractID <- factor(hour_2013$tractID)
hour_2013$mth <- factor(hour_2013$mth,
  levels = c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12),
  labels = c("Jan", "Feb", "Mar", "Apr", "May", "Jun",
"Jul", "Aug", "Sep", "Oct", "Nov", "Dec"),
  ordered = TRUE)
hour_2013$hr <- factor(hour_2013$hr,
  levels =
c(0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23),
  ordered = TRUE)
hour_2013$weekday <- factor(hour_2013$weekday,
  levels = c(0, 1, 2, 3, 4, 5, 6),
  labels = c("Sun", "Mon", "Tue", "Wed", "Thu",
"Fri", "Sat"))
hour_2013$workingday <- factor(hour_2013$workingday,
  levels = c(0, 1),
  labels = c("nonworkday", "workday"))
hour_2013$holiday <- factor(hour_2013$holiday)
hour_2013$weather <- factor(hour_2013$weather,
  levels = c(1, 2, 3, 4),
  labels = c("very good", "good", "bad", "very
bad"),
  ordered = TRUE)

str(hour_2013)

## 'data.frame': 399458 obs. of 17 variables:
## $ dteday : Date, format: "2013-01-01" "2013-01-01" ...

```

```
## $ tractID      : Factor w/ 113 levels "1","2","3","4",...: 2 8 16 17 19 21 29
30 32 36 ...
## $ jday         : int   1 1 1 1 1 1 1 1 1 1 ...
## $ season       : int   1 1 1 1 1 1 1 1 1 1 ...
## $ mth          : Ord.factor w/ 12 levels "Jan"<"Feb"<"Mar"<...: 1 1 1 1 1 1 1
1 1 1 ...
## $ hr           : Ord.factor w/ 24 levels "0"<"1"<"2"<"3"<...: 1 1 1 1 1 1 1 1
1 1 ...
## $ holiday      : Factor w/ 2 levels "0","1": 2 2 2 2 2 2 2 2 2 2 ...
## $ weekday      : Factor w/ 7 levels "Sun","Mon","Tue",...: 3 3 3 3 3 3 3 3 3
3 ...
## $ workingday   : Factor w/ 2 levels "nonworkday","workday": 1 1 1 1 1 1 1 1
1 1 ...
## $ weather      : Ord.factor w/ 4 levels "very good"<"good"<...: 2 2 2 2 2 2 2
2 2 2 ...
## $ temp         : num   3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 ...
## $ humidity     : int   68 68 68 68 68 68 68 68 68 68 ...
## $ windspeed    : num   11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 11.1 ...
## $ casual       : int    0 0 0 0 0 0 1 2 0 0 ...
## $ registered   : int    1 1 1 1 2 1 3 3 1 4 ...
## $ cnt          : int    1 1 1 1 2 1 4 5 1 4 ...
## $ mday         : int    1 1 1 1 1 1 1 1 1 1 ...
```

```
ly <- matrix(c(1,2,3,4,4,4), nrow = 2, ncol = 3, byrow = TRUE)
```

```
layout(mat = ly, heights = c(0.85, 0.15))
```

```
par(mar = c(0, 6, 4, 0))
```

```
boxplot(hour_2013$registered ~ hour_2013$weather,
        main = "Registered users",
        col = c("yellow", "orange", "forestgreen"),
        xaxt = "n", ylab = "bike count")
```

```
boxplot(hour_2013$casual ~ hour_2013$weather,
        main = "Casual users",
        col = c("yellow", "orange", "forestgreen"),
        xaxt = "n", ylab = "bike count")
```

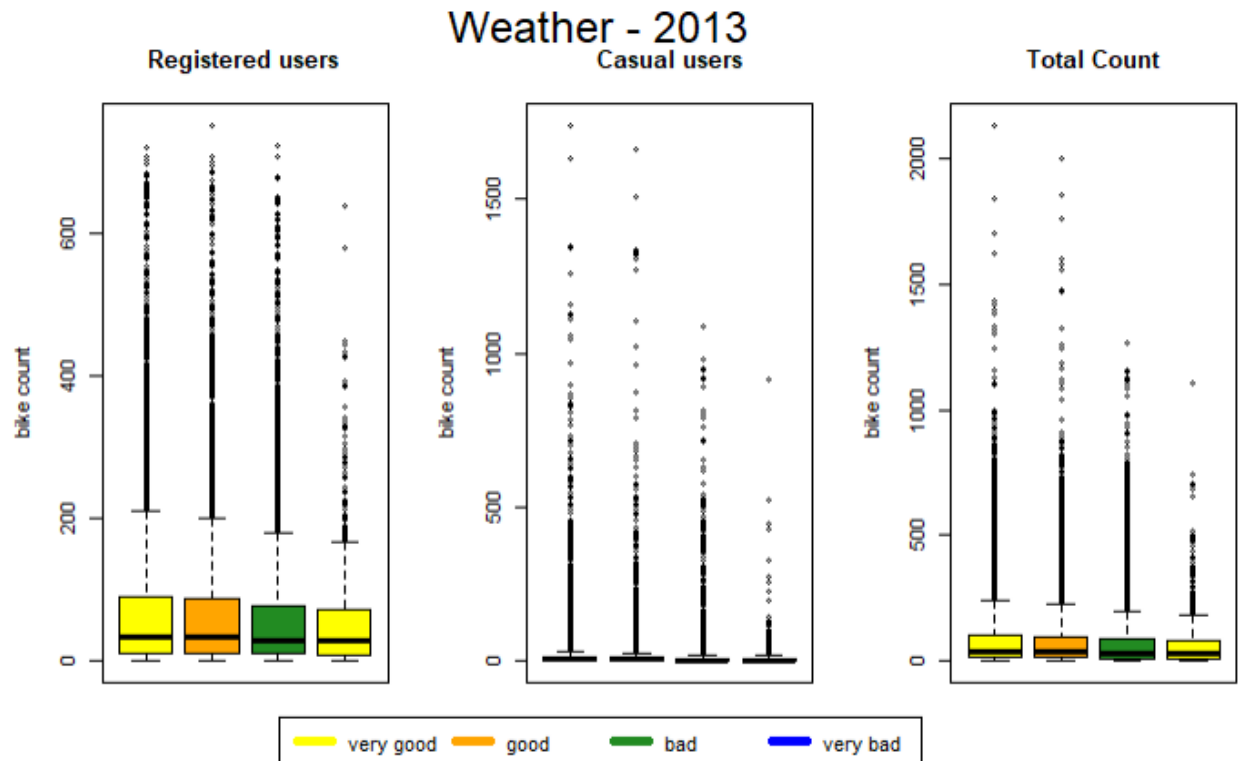
```
boxplot(hour_2013$cnt ~ hour_2013$weather,
        main = "Total Count",
        col = c("yellow", "orange", "forestgreen"),
        xaxt = "n", ylab = "bike count")
```

```
mtext("Weather - 2013", side = 3, line = -1.5, outer = TRUE, cex = 1.5)
```

```
par(mar = c(0, 0, 0, 0))
```

```
plot(1, type = "n", axes=FALSE, xlab = "", ylab = "")
```

```
legend("center", inset = 0,
      legend = c("very good", "good", "bad", "very bad"),
      col = c("yellow", "orange", "forestgreen", "blue"),
      lwd = 5, cex = 1, horiz = TRUE)
```

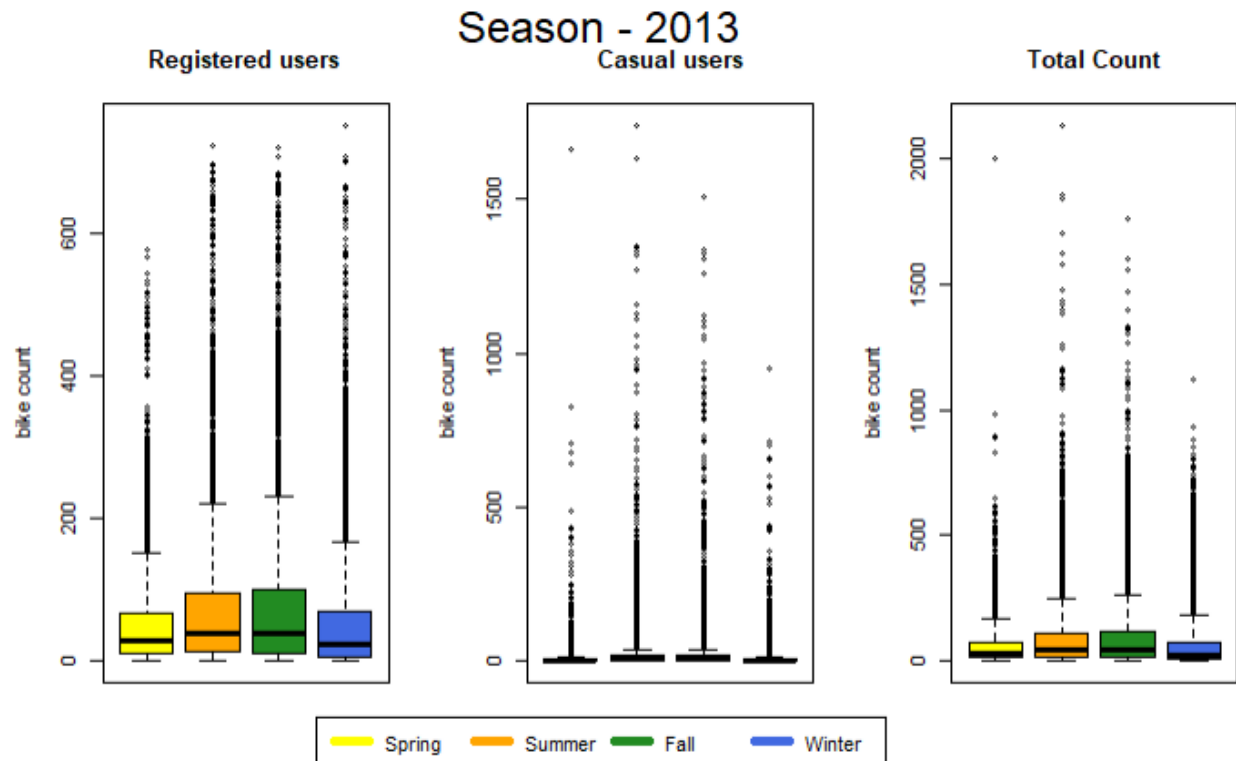


```
ly <- matrix(c(1,2,3,4,4,4), nrow = 2, ncol = 3, byrow = TRUE)

layout(mat = ly, heights = c(0.85, 0.15))

par(mar = c(0, 6, 4, 0))
boxplot(hour_2013$registered ~ hour_2013$season,
        main = "Registered users",
        col = c("yellow", "orange", "forestgreen", "royalblue"),
        xaxt = "n", ylab = "bike count")
boxplot(hour_2013$casual ~ hour_2013$season,
        main = "Casual users",
        col = c("yellow", "orange", "forestgreen", "royalblue"),
        xaxt = "n", ylab = "bike count")
boxplot(hour_2013$cnt ~ hour_2013$season,
        main = "Total Count",
        col = c("yellow", "orange", "forestgreen", "royalblue"),
        xaxt = "n", ylab = "bike count")
mtext("Season - 2013", side = 3, line = -1.5, outer = TRUE, cex = 1.5)

par(mar = c(0, 0, 0, 0))
plot(1, type = "n", axes=FALSE, xlab = "", ylab = "")
legend("center", inset = 0,
      legend = c("Spring", "Summer", "Fall", "Winter"),
      col = c("yellow", "orange", "forestgreen", "royalblue"),
      lwd = 5, cex = 1, horiz = TRUE)
```

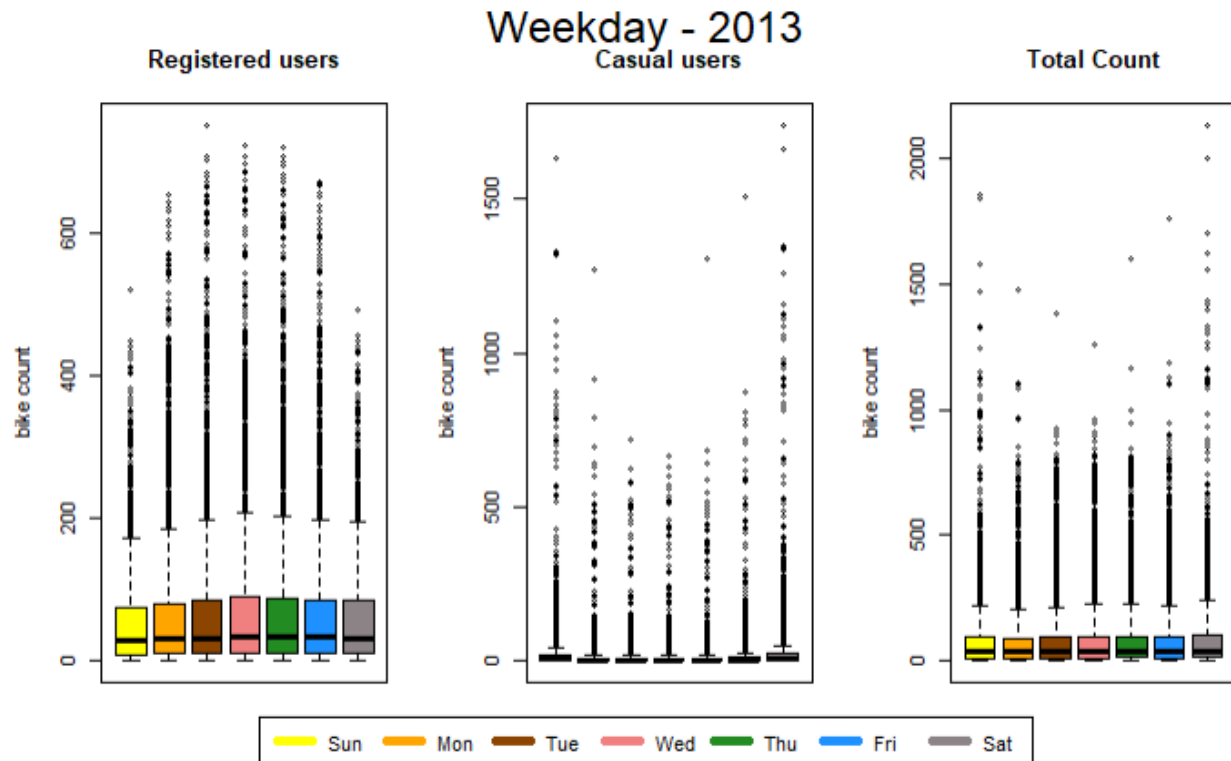


```

ly <- matrix(c(1,2,3,4,4,4), nrow = 2, ncol = 3, byrow = TRUE)
cols <- c("yellow", "orange", "darkorange4", "lightcoral", "forestgreen",
"dodgerblue", "lavenderblush4")
layout(mat = ly, heights = c(0.85, 0.15))

par(mar = c(0, 4, 4, 2))
boxplot(hour_2013$registered ~ hour_2013$weekday,
        main = "Registered users",
        col = cols, xaxt = "n", ylab = "bike count")
boxplot(hour_2013$casual ~ hour_2013$weekday,
        main = "Casual users",
        col = cols, xaxt = "n", ylab = "bike count")
boxplot(hour_2013$cnt ~ hour_2013$weekday,
        main = "Total Count",
        col = cols, xaxt = "n", ylab = "bike count")
mtext("Weekday - 2013", side = 3, line = -1.5, outer = TRUE, cex = 1.5)

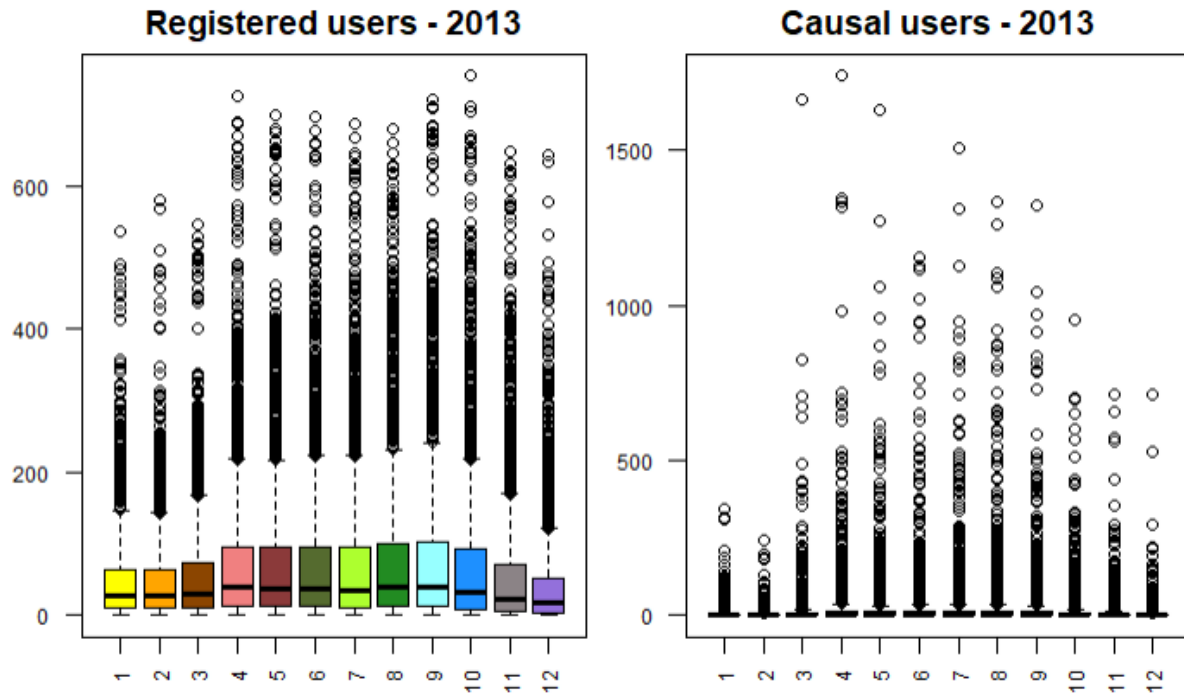
par(mar = c(0, 0, 0, 0))
plot(1, type = "n", axes=FALSE, xlab = "", ylab = "")
legend("center", inset = 0,
      legend = c("Sun", "Mon", "Tue", "Wed", "Thu", "Fri", "Sat"),
      col = cols, lwd = 5, cex = 1, horiz = TRUE)
  
```



```
par(mfrow = c(1, 2), mar = c(3, 3, 2, 0))
cols = c("yellow", "orange", "darkorange4", "lightcoral", "indianred4",
"darkolivegreen", "greenyellow", "forestgreen", "darkslategray1",
"dodgerblue", "lavenderblush4", "mediumpurple")

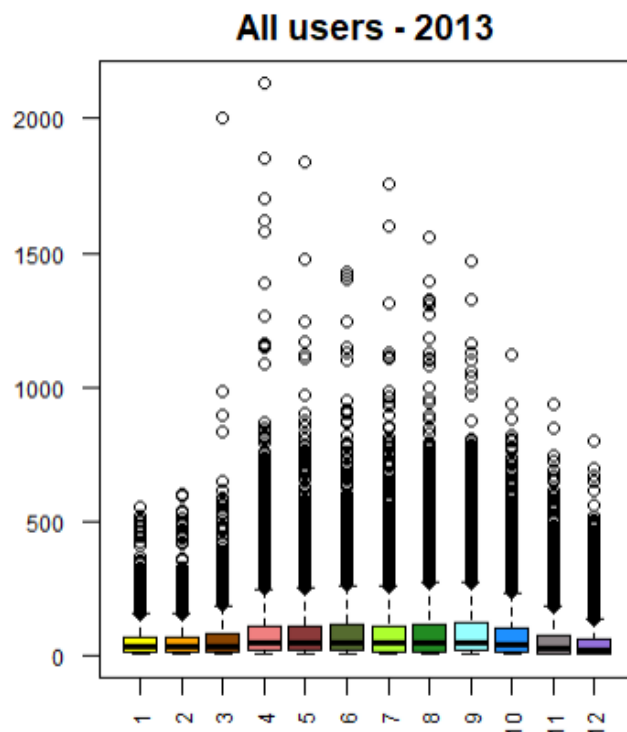
#bike <- subset(day_2013, select = c(jday, yr, mth, registered, casual, cnt))
boxplot(hour_2013$registered ~ hour_2013$mth,
        main = "Registered users - 2013",
        las = 2, cex.axis = 0.75,
        col = cols
        )

boxplot(hour_2013$casual ~ hour_2013$mth,
        main = "Causal users - 2013",
        las = 2, cex.axis = 0.75,
        col = cols)
```

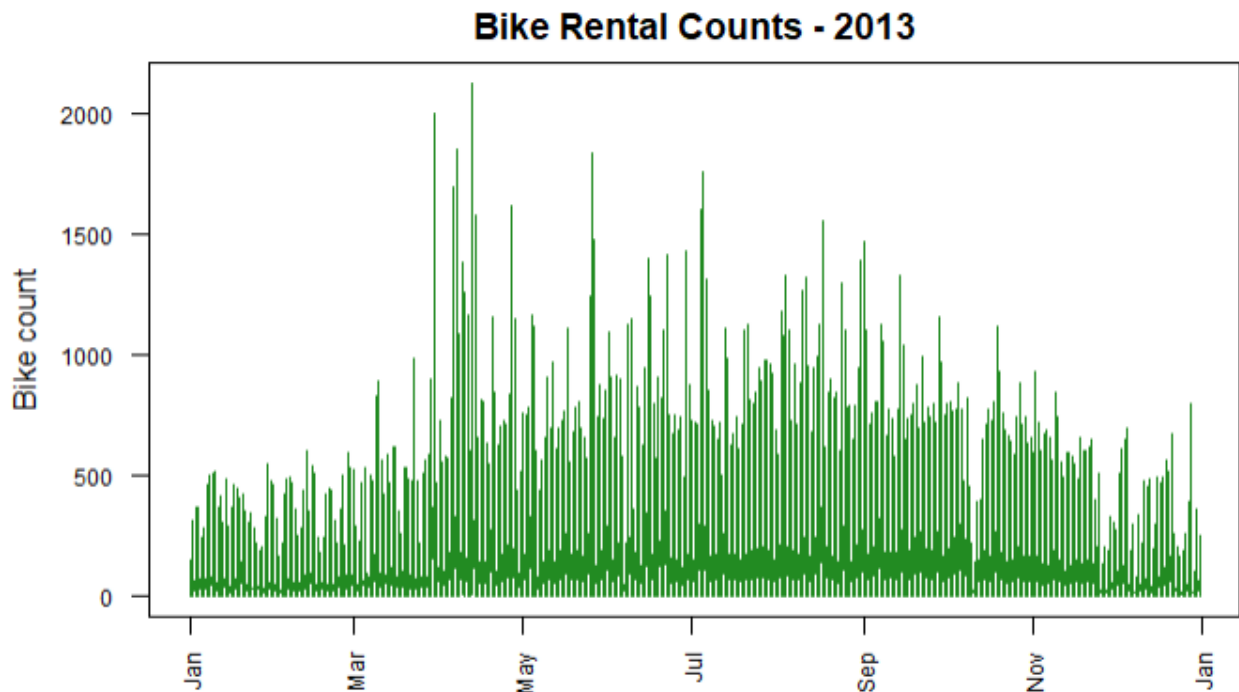


```
par(mfrow = c(1, 2), mar = c(3, 3, 2, 0))
```

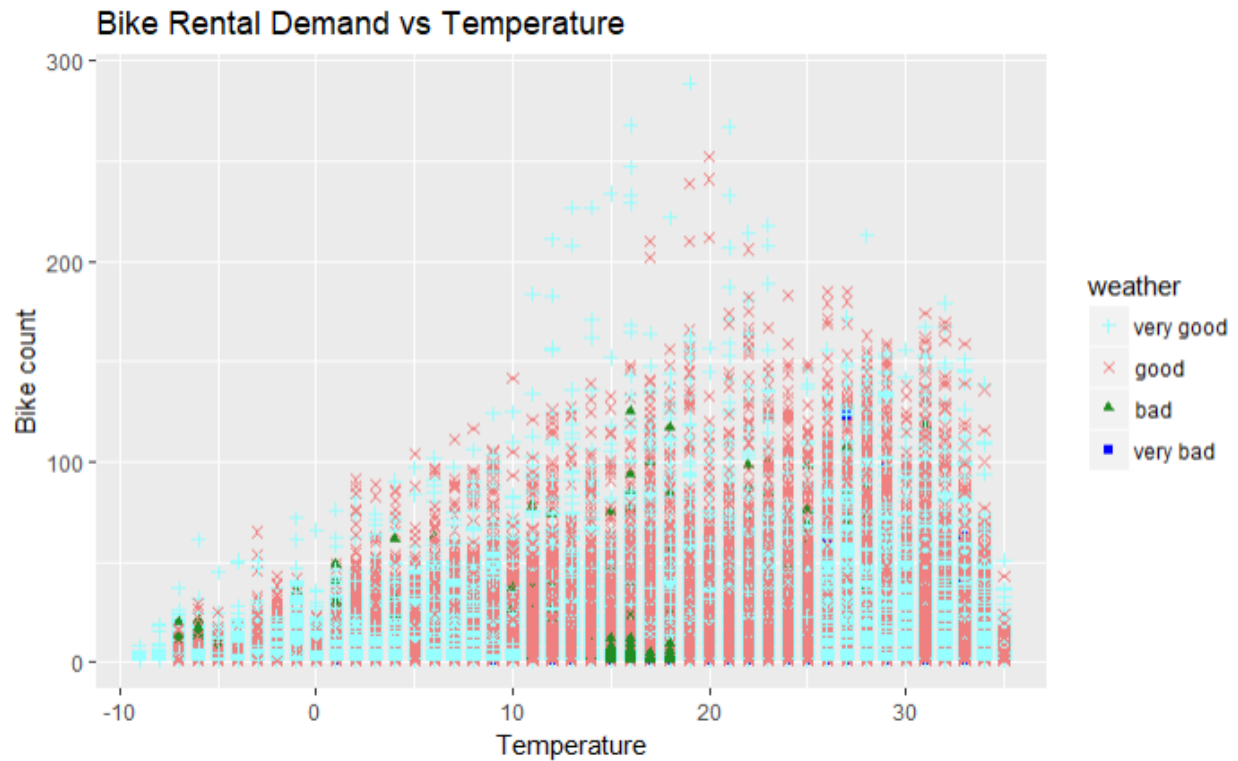
```
boxplot(hour_2013$cnt ~ hour_2013$mth,
        main = "All users - 2013",
        las = 2, cex.axis = 0.75,
        col = cols)
```



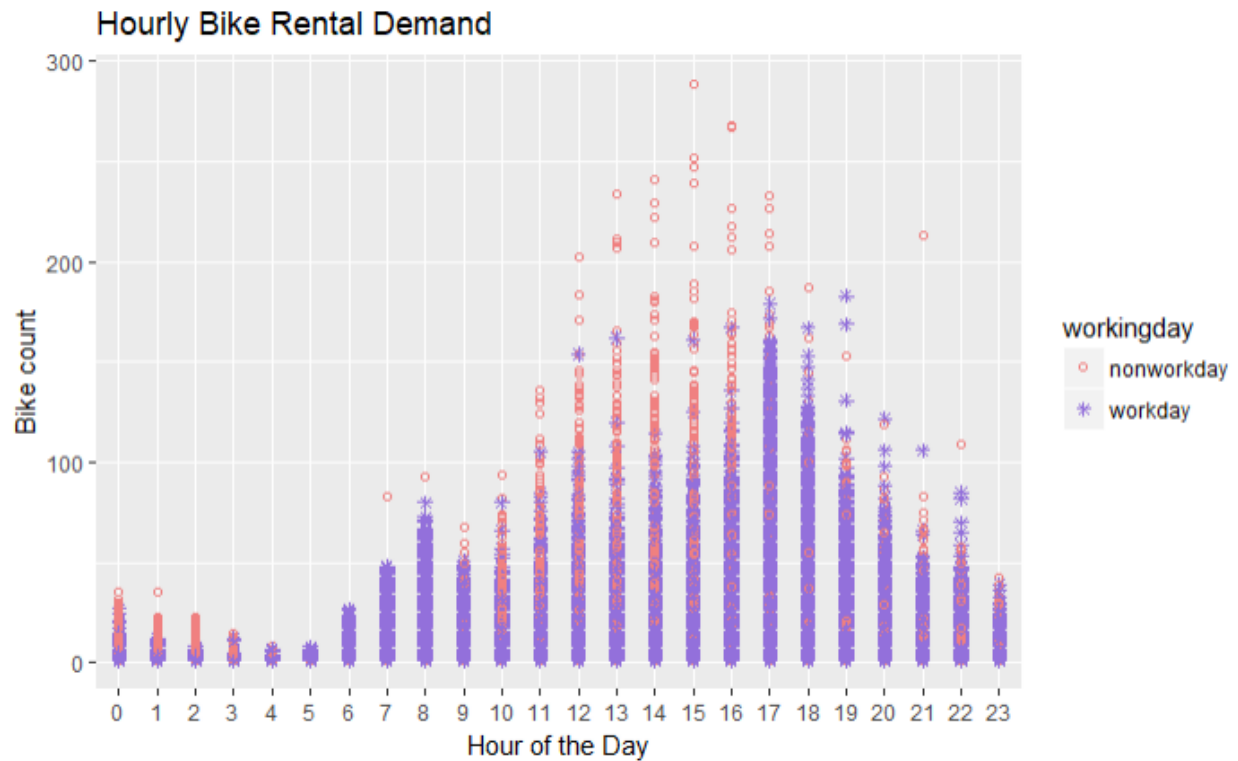

```
plot(hour_2013$dteday, hour_2013$cnt,
     type = "l", lwd = 0.7, las = 1, cex.axis = 0.75,
     col = "forestgreen", las = 2, cex.axis = 0.75,
     ylab = "Bike count", xlab = "",
     main = "Bike Rental Counts - 2013")
```



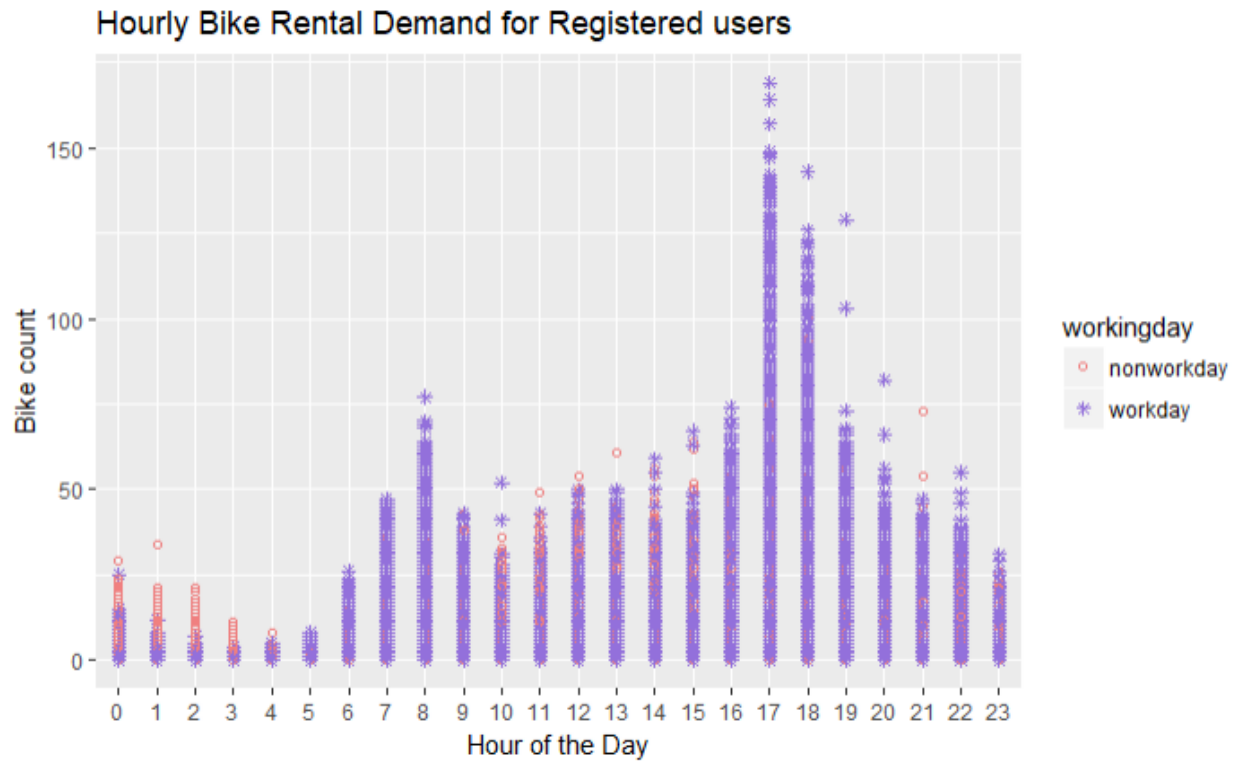
```
library(ggplot2)
p <- ggplot(hour_2013, aes(round(temp, digits = 0), cnt,
                           group = weather, colour = weather,
                           shape = weather)) +
  geom_point() +
  xlab("Temperature") +
  ylab("Bike count") +
  ggtitle("Bike Rental Demand vs Temperature")
print(p + scale_colour_manual(values = c("darkslategray1", "lightcoral",
"forestgreen", "blue"))
      + scale_shape_manual(values = c(3, 4, 17, 15)))
```



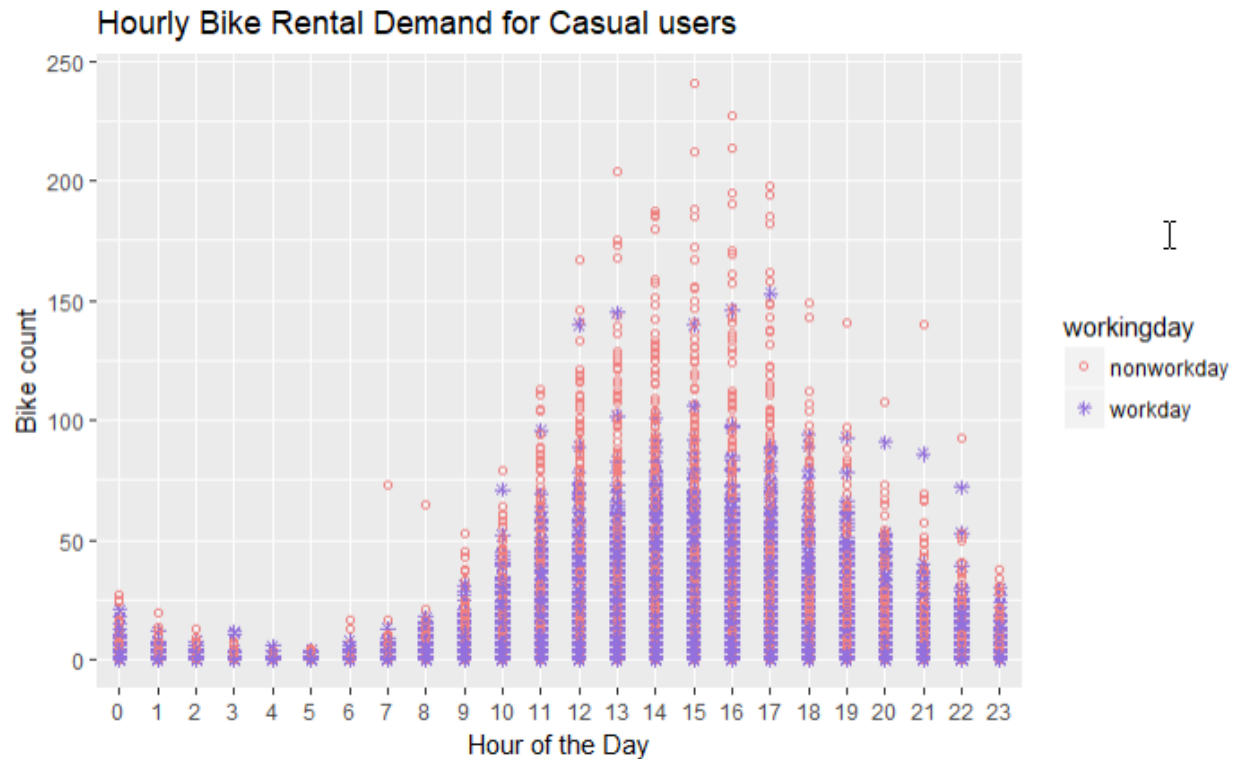
```
library(ggplot2)
p <- ggplot(hour_2013, aes(hr, cnt,
                           group = workingday, colour = workingday,
                           shape = workingday)) +
  geom_point() +
  xlab("Hour of the Day") +
  ylab("Bike count") +
  ggtitle("Hourly Bike Rental Demand")
print(p + scale_colour_manual(values = c("lightcoral", "mediumpurple"))
      + scale_shape_manual(values = c(1, 8)))
```



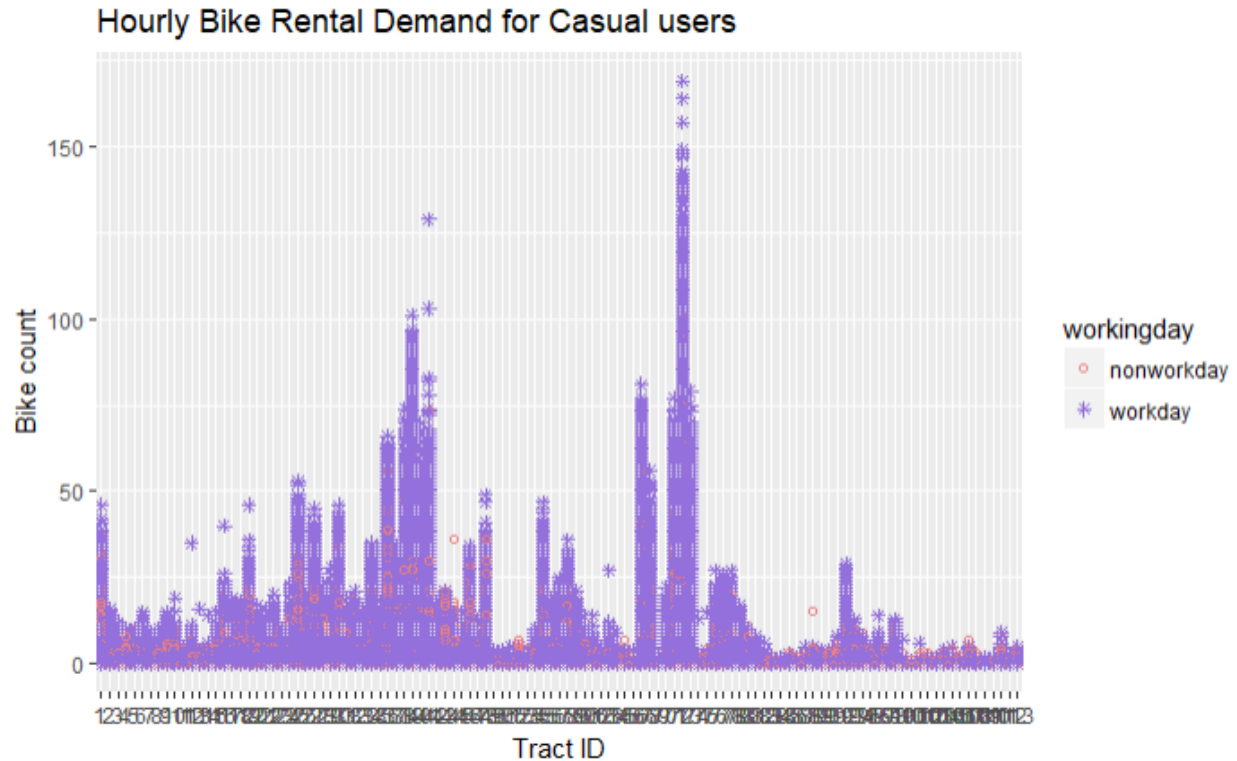
```
library(ggplot2)
p <- ggplot(hour_2013, aes(hr, registered,
                           group = workingday, colour = workingday,
                           shape = workingday)) +
  geom_point() +
  xlab("Hour of the Day") +
  ylab("Bike count") +
  ggtitle("Hourly Bike Rental Demand for Registered users")
print(p + scale_colour_manual(values = c("lightcoral", "mediumpurple"))
      + scale_shape_manual(values = c(1, 8)))
```



```
library(ggplot2)
p <- ggplot(hour_2013, aes(hr, casual,
                           group = workingday, colour = workingday,
                           shape = workingday)) +
  geom_point() +
  xlab("Hour of the Day") +
  ylab("Bike count") +
  ggtitle("Hourly Bike Rental Demand for Casual users")
print(p + scale_colour_manual(values = c("lightcoral", "mediumpurple"))
      + scale_shape_manual(values = c(1, 8)))
```



```
library(ggplot2)
p <- ggplot(hour_2013, aes(tractID, registered,
                           group = workingday, colour = workingday,
                           shape = workingday)) +
  geom_point() +
  xlab("Tract ID") +
  ylab("Bike count") +
  ggtitle("Hourly Bike Rental Demand for Casual users")
print(p + scale_colour_manual(values = c("lightcoral", "mediumpurple"))
      + scale_shape_manual(values = c(1, 8)))
```



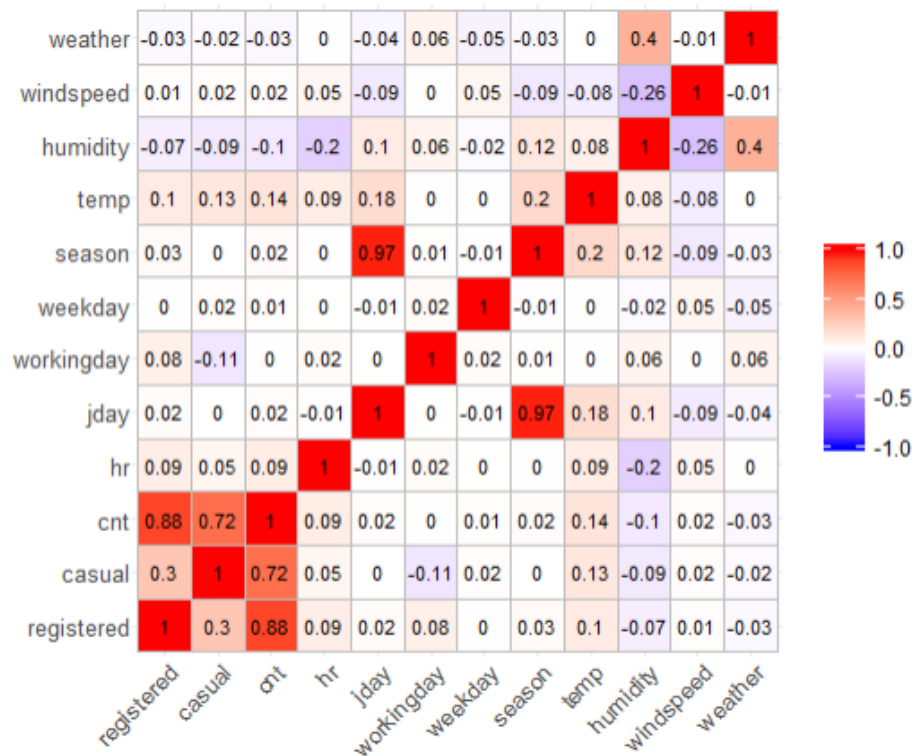
```
library(ggplot2)
p <- ggplot(hour_2013, aes(tractID, casual,
                           group = workingday, colour = workingday,
                           shape = workingday)) +
  geom_point() +
  xlab("Tract ID") +
  ylab("Bike count") +
  ggtitle("Hourly Bike Rental Demand for Casual users")
print(p + scale_colour_manual(values = c("lightcoral", "mediumpurple"))
      + scale_shape_manual(values = c(1, 8)))
```



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```
std.err) :
## function cannot be evaluated at initial parameters

ggcorrplot(a["correlations"]$correlations, hc.order = FALSE, lab = TRUE,
  legend.title = "", lab_size = 3) +
  theme(axis.text.x = element_text(size = 10, angle = 45, margin=margin(-
2,0,0,0)),
  axis.text.y = element_text(size = 10, margin=margin(0,-2,0,0)))
```



```
minmax <- function(x) {
  return ((x - min(x)) / (max(x) - min(x)))
}
stdize <- function(x) {
  return (x / sd(x))
}

hour_2013 <- read.csv(file="D:/Capston/2013_Hour_By_Tract.csv", header=TRUE,
  sep=";",
  stringsAsFactors = FALSE)

hour_2013$dteday <- as.Date(hour_2013$dteday)
hour_2013$mday <- as.integer(format(hour_2013$dteday, "%d"))

hour_2013 <- subset(hour_2013, select = -c(dteday, yr, atemp))

hour_2013$tractID <- apply(as.matrix(hour_2013$tractID), 2, minmax)
```



```

hour_2013$hr <- apply(as.matrix(hour_2013$hr), 2, stdize)
hour_2013$weekday <- apply(as.matrix(hour_2013$weekday), 2, stdize)
hour_2013$weather <- apply(as.matrix(hour_2013$weather), 2, stdize)
hour_2013$temp <- apply(as.matrix(hour_2013$temp), 2, stdize)

hour_2013$windspeed <- log1p(hour_2013$windspeed)
hour_2013$casual <- log1p(hour_2013$casual)
hour_2013$registered <- log1p(hour_2013$registered)

str(hour_2013)

## 'data.frame':    399458 obs. of  16 variables:
## $ tractID      : num [1:399458, 1] 0.00893 0.0625 0.13393 0.14286 0.16071
## ...
## $ jday         : int  1 1 1 1 1 1 1 1 1 1 ...
## $ season       : int  1 1 1 1 1 1 1 1 1 1 ...
## $ mth          : int  1 1 1 1 1 1 1 1 1 1 ...
## $ hr           : num [1:399458, 1] 0 0 0 0 0 0 0 0 0 0 ...
## $ holiday      : int  1 1 1 1 1 1 1 1 1 1 ...
## $ weekday      : num [1:399458, 1] 0.999 0.999 0.999 0.999 0.999 ...
## $ workingday   : int  0 0 0 0 0 0 0 0 0 0 ...
## $ weather      : num [1:399458, 1] 3.33 3.33 3.33 3.33 3.33 ...
## $ temp         : num [1:399458, 1] 0.348 0.348 0.348 0.348 0.348 ...
## $ humidity     : int  68 68 68 68 68 68 68 68 68 68 ...
## $ windspeed    : num  2.49 2.49 2.49 2.49 2.49 ...
## $ casual       : num  0 0 0 0 0 ...
## $ registered   : num  0.693 0.693 0.693 0.693 1.099 ...
## $ cnt          : int  1 1 1 1 2 1 4 5 1 4 ...
## $ mday         : int  1 1 1 1 1 1 1 1 1 1 ...

summary(hour_2013)

##      tractID.V1      jday      season      mth
## Min.   :0.0000000 Min.   : 1.0 Min.   :1.000 Min.   : 1.000
## 1st Qu.:0.2142857 1st Qu.:109.0 1st Qu.:2.000 1st Qu.: 4.000
## Median :0.3482143 Median :195.0 Median :3.000 Median : 7.000
## Mean   :0.3881064 Mean   :190.7 Mean   :2.596 Mean   : 6.781
## 3rd Qu.:0.5892857 3rd Qu.:275.0 3rd Qu.:4.000 3rd Qu.:10.000
## Max.   :1.0000000 Max.   :365.0 Max.   :4.000 Max.   :12.000
##      hr.V1      holiday      weekday.V1      workingday
## Min.   :0.000000 Min.   :0.00000 Min.   :0.0000000 Min.   :0.0000
## 1st Qu.:1.528959 1st Qu.:0.00000 1st Qu.:0.4993343 1st Qu.:0.0000
## Median :2.378380 Median :0.00000 Median :1.4980029 Median :1.0000
## Mean   :2.245595 Mean   :0.02707 Mean   :1.5174958 Mean   :0.6847
## 3rd Qu.:3.057918 3rd Qu.:0.00000 3rd Qu.:2.4966715 3rd Qu.:1.0000
## Max.   :3.907339 Max.   :1.00000 Max.   :2.9960058 Max.   :1.0000
##      weather.V1      temp.V1      humidity      windspeed
## Min.   :1.663926 Min.   : -0.938404 Min.   : 12.0 Min.   :0.6931
## 1st Qu.:1.663926 1st Qu.: 0.875140 1st Qu.: 44.0 1st Qu.:2.3321

```

```
## Median :3.327853 Median : 1.813544 Median : 58.0 Median :2.7600
## Mean :2.831367 Mean : 1.742316 Mean : 58.8 Mean :2.7064
## 3rd Qu.:3.327853 3rd Qu.: 2.572702 3rd Qu.: 74.0 3rd Qu.:3.0402
## Max. :6.655705 Max. : 3.690351 Max. :100.0 Max. :4.0019
## casual registered cnt mday
## Min. :0.0000 Min. :0.0000 Min. : 1.000 Min. : 1.00
## 1st Qu.:0.0000 1st Qu.:0.6931 1st Qu.: 1.000 1st Qu.: 8.00
## Median :0.0000 Median :1.3863 Median : 3.000 Median :16.00
## Mean :0.3943 Mean :1.4314 Mean : 6.467 Mean :15.67
## 3rd Qu.:0.6931 3rd Qu.:1.9459 3rd Qu.: 7.000 3rd Qu.:23.00
## Max. :5.4889 Max. :5.1358 Max. :289.000 Max. :31.00
```

```
library(partykit)
```

```
## Warning: package 'partykit' was built under R version 3.4.2
```

```
## Loading required package: grid
```

```
library(grid)
```

```
train=hour_2013[as.integer(substr(hour_2013$mday,9,10))<21,]
test=hour_2013[as.integer(substr(hour_2013$mday,9,10))>20,]
```

```
model = ctree(casual ~ tractID, data = hour_2013 )
```

```
print(model)
```

```
##
## Model formula:
## casual ~ tractID
##
## Fitted party:
## [1] root
## | [2] tractID <= 0.30357
## | | [3] tractID <= 0: 0.995 (n = 6837, err = 6625.6)
## | | [4] tractID > 0
## | | | [5] tractID <= 0.20536
## | | | [6] tractID <= 0.00893: 0.387 (n = 4486, err = 1431.4)
## | | | [7] tractID > 0.00893
## | | | [8] tractID <= 0.08929
## | | | [9] tractID <= 0.02679
## | | | [10] tractID <= 0.01786: 0.219 (n = 3143, err
## | | | = 535.4)
## | | | [11] tractID > 0.01786: 0.199 (n = 4195, err =
## | | | 704.6)
## | | | [12] tractID > 0.02679: 0.165 (n = 24379, err =
## | | | 3229.4)
## | | | [13] tractID > 0.08929
## | | | [14] tractID <= 0.125
## | | | [15] tractID <= 0.09821: 0.110 (n = 2087, err
```

```

= 174.2)
## | | | | | | | [16] tractID > 0.09821: 0.075 (n = 6102, err =
341.1)
## | | | | | | | [17] tractID > 0.125
## | | | | | | | [18] tractID <= 0.16071
## | | | | | | | [19] tractID <= 0.15179
## | | | | | | | [20] tractID <= 0.13393: 0.173 (n =
6633, err = 866.9)
## | | | | | | | [21] tractID > 0.13393
## | | | | | | | [22] tractID <= 0.14286: 0.126 (n
= 5889, err = 550.8)
## | | | | | | | [23] tractID > 0.14286: 0.147 (n =
6426, err = 723.5)
## | | | | | | | [24] tractID > 0.15179: 0.227 (n = 7005,
err = 1249.1)
## | | | | | | | [25] tractID > 0.16071
## | | | | | | | [26] tractID <= 0.16964: 0.097 (n = 4387,
err = 324.3)
## | | | | | | | [27] tractID > 0.16964: 0.129 (n = 14167,
err = 1396.0)
## | | | | [28] tractID > 0.20536
## | | | | [29] tractID <= 0.23214
## | | | | [30] tractID <= 0.22321
## | | | | [31] tractID <= 0.21429: 0.355 (n = 7429, err =
2059.4)
## | | | | [32] tractID > 0.21429: 0.293 (n = 6881, err =
1711.3)
## | | | | [33] tractID > 0.22321: 0.478 (n = 7480, err = 2809.0)
## | | | | [34] tractID > 0.23214
## | | | | [35] tractID <= 0.25893
## | | | | [36] tractID <= 0.25
## | | | | [37] tractID <= 0.24107: 0.220 (n = 6893, err
= 1234.3)
## | | | | [38] tractID > 0.24107: 0.252 (n = 6761, err =
1409.7)
## | | | | [39] tractID > 0.25: 0.292 (n = 7295, err =
1810.1)
## | | | | [40] tractID > 0.25893
## | | | | [41] tractID <= 0.28571: 0.156 (n = 14320, err =
1773.6)
## | | | | [42] tractID > 0.28571
## | | | | [43] tractID <= 0.29464: 0.257 (n = 6917, err
= 1415.1)
## | | | | [44] tractID > 0.29464: 0.217 (n = 4408, err =
745.8)
## | [45] tractID > 0.30357
## | [46] tractID <= 0.35714
## | [47] tractID <= 0.34821
## | [48] tractID <= 0.32143
## | [49] tractID <= 0.3125: 0.837 (n = 7888, err = 5425.4)

```

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## | | | | | [50] tractID > 0.3125: 0.301 (n = 7348, err = 1834.0)
## | | | | | [51] tractID > 0.32143
## | | | | | [52] tractID <= 0.33929
## | | | | | [53] tractID <= 0.33036: 0.885 (n = 7701, err =
5818.4)
## | | | | | [54] tractID > 0.33036: 1.256 (n = 7477, err =
8984.7)
## | | | | | [55] tractID > 0.33929: 0.731 (n = 7422, err = 5055.3)
## | | | | | [56] tractID > 0.34821: 2.199 (n = 6942, err = 15274.7)
## | | | [57] tractID > 0.35714
## | | | [58] tractID <= 0.58036
## | | | [59] tractID <= 0.50893
## | | | [60] tractID <= 0.47321
## | | | [61] tractID <= 0.41964: 0.232 (n = 38286, err =
8923.8)
## | | | | | [62] tractID > 0.41964: 0.069 (n = 5907, err =
320.5)
## | | | | | [63] tractID > 0.47321
## | | | | | [64] tractID <= 0.49107
## | | | | | [65] tractID <= 0.48214: 0.266 (n = 6396, err
= 1387.9)
## | | | | | [66] tractID > 0.48214: 0.347 (n = 5876, err =
1860.2)
## | | | | | [67] tractID > 0.49107: 0.235 (n = 12803, err =
2438.3)
## | | | | | [68] tractID > 0.50893
## | | | | | [69] tractID <= 0.5625: 0.134 (n = 16191, err =
1710.1)
## | | | | | [70] tractID > 0.5625
## | | | | | [71] tractID <= 0.57143: 0.109 (n = 1158, err =
108.6)
## | | | | | [72] tractID > 0.57143: 0.074 (n = 414, err =
25.9)
## | | | | | [73] tractID > 0.58036
## | | | | | [74] tractID <= 0.64286
## | | | | | [75] tractID <= 0.59821
## | | | | | [76] tractID <= 0.58929: 0.981 (n = 7138, err =
6057.9)
## | | | | | [77] tractID > 0.58929: 1.120 (n = 6454, err =
7387.9)
## | | | | | [78] tractID > 0.59821
## | | | | | [79] tractID <= 0.625
## | | | | | [80] tractID <= 0.61607
## | | | | | [81] tractID <= 0.60714: 0.092 (n = 66,
err = 5.0)
## | | | | | [82] tractID > 0.60714: 0.393 (n = 4953,
err = 1966.8)
## | | | | | [83] tractID > 0.61607: 0.637 (n = 7571, err =
4018.2)
## | | | | | [84] tractID > 0.625

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## | | | | | | | [85] tractID <= 0.63393: 1.052 (n = 7733, err
= 7001.9)
## | | | | | | | [86] tractID > 0.63393: 0.779 (n = 7029, err =
4839.9)
## | | | | | [87] tractID > 0.64286
## | | | | | [88] tractID <= 0.66071: 0.133 (n = 1470, err = 157.9)
## | | | | | [89] tractID > 0.66071
## | | | | | [90] tractID <= 0.86607
## | | | | | [91] tractID <= 0.85714
## | | | | | [92] tractID <= 0.83929
## | | | | | [93] tractID <= 0.80357: 0.287 (n =
34573, err = 8543.3)
## | | | | | [94] tractID > 0.80357
## | | | | | [95] tractID <= 0.8125: 0.493 (n =
5942, err = 2360.6)
## | | | | | [96] tractID > 0.8125: 0.277 (n =
8588, err = 1930.3)
## | | | | | [97] tractID > 0.83929
## | | | | | [98] tractID <= 0.84821: 0.142 (n =
2471, err = 298.7)
## | | | | | [99] tractID > 0.84821: 0.226 (n =
1716, err = 285.0)
## | | | | | [100] tractID > 0.85714: 0.434 (n = 4766, err
= 1761.7)
## | | | | | [101] tractID > 0.86607: 0.192 (n = 3059, err =
457.3)
##
## Number of inner nodes: 50
## Number of terminal nodes: 51

model = ctree(registered ~ tractID, data = hour_2013 )

print(model)

##
## Model formula:
## registered ~ tractID
##
## Fitted party:
## [1] root
## | [2] tractID <= 0.6875
## | | [3] tractID <= 0.20536
## | | | [4] tractID <= 0: 1.764 (n = 6837, err = 4237.3)
## | | | [5] tractID > 0
## | | | [6] tractID <= 0.125
## | | | [7] tractID <= 0.08036
## | | | [8] tractID <= 0.0625
## | | | [9] tractID <= 0.00893: 1.005 (n = 4486, err =
1333.2)
## | | | [10] tractID > 0.00893

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## | | | | | | | | | [11] tractID <= 0.04464
## | | | | | | | | | [12] tractID <= 0.01786: 0.848 (n =
3143, err = 645.7)
## | | | | | | | | | [13] tractID > 0.01786: 0.947 (n =
12037, err = 2355.9)
## | | | | | | | | | [14] tractID > 0.04464
## | | | | | | | | | [15] tractID <= 0.05357: 0.821 (n =
2892, err = 530.8)
## | | | | | | | | | [16] tractID > 0.05357: 0.890 (n =
3012, err = 488.7)
## | | | | | | | | | [17] tractID > 0.0625
## | | | | | | | | | [18] tractID <= 0.07143: 1.153 (n = 5064, err
= 1352.9)
## | | | | | | | | | [19] tractID > 0.07143: 1.053 (n = 4566, err =
969.3)
## | | | | | | | | | [20] tractID > 0.08036
## | | | | | | | | | [21] tractID <= 0.11607: 0.818 (n = 6232, err =
804.2)
## | | | | | | | | | [22] tractID > 0.11607: 0.921 (n = 2960, err =
543.8)
## | | | | | | | | | [23] tractID > 0.125
## | | | | | | | | | [24] tractID <= 0.16071
## | | | | | | | | | [25] tractID <= 0.15179
## | | | | | | | | | [26] tractID <= 0.13393: 1.424 (n = 6633, err
= 2463.8)
## | | | | | | | | | [27] tractID > 0.13393
## | | | | | | | | | [28] tractID <= 0.14286: 1.272 (n = 5889,
err = 1775.6)
## | | | | | | | | | [29] tractID > 0.14286: 1.362 (n = 6426,
err = 2086.3)
## | | | | | | | | | [30] tractID > 0.15179: 1.645 (n = 7005, err =
3336.1)
## | | | | | | | | | [31] tractID > 0.16071
## | | | | | | | | | [32] tractID <= 0.19643
## | | | | | | | | | [33] tractID <= 0.1875
## | | | | | | | | | [34] tractID <= 0.16964: 1.052 (n = 4387,
err = 1065.9)
## | | | | | | | | | [35] tractID > 0.16964
## | | | | | | | | | [36] tractID <= 0.17857: 1.160 (n =
5664, err = 1478.4)
## | | | | | | | | | [37] tractID > 0.17857: 1.073 (n =
3876, err = 970.8)
## | | | | | | | | | [38] tractID > 0.1875: 0.877 (n = 633, err =
105.2)
## | | | | | | | | | [39] tractID > 0.19643: 1.309 (n = 3994, err =
1371.4)
## | | | | | | | | | [40] tractID > 0.20536
## | | | | | | | | | [41] tractID <= 0.35714
## | | | | | | | | | [42] tractID <= 0.30357
## | | | | | | | | | [43] tractID <= 0.25893

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## | | | | | | | [44] tractID <= 0.23214
## | | | | | | | [45] tractID <= 0.22321
## | | | | | | | [46] tractID <= 0.21429: 1.851 (n = 7429,
err = 4084.1)
## | | | | | | | [47] tractID > 0.21429: 1.488 (n = 6881,
err = 2470.8)
## | | | | | | | [48] tractID > 0.22321: 1.914 (n = 7480, err =
4378.8)
## | | | | | | | [49] tractID > 0.23214
## | | | | | | | [50] tractID <= 0.25
## | | | | | | | [51] tractID <= 0.24107: 1.550 (n = 6893,
err = 2825.8)
## | | | | | | | [52] tractID > 0.24107: 1.491 (n = 6761,
err = 2612.8)
## | | | | | | | [53] tractID > 0.25: 1.710 (n = 7295, err =
3678.1)
## | | | | | | | [54] tractID > 0.25893
## | | | | | | | [55] tractID <= 0.28571
## | | | | | | | [56] tractID <= 0.27679
## | | | | | | | [57] tractID <= 0.26786: 1.183 (n = 5243,
err = 1501.9)
## | | | | | | | [58] tractID > 0.26786: 1.389 (n = 6242,
err = 2232.0)
## | | | | | | | [59] tractID > 0.27679: 1.060 (n = 2835, err =
670.9)
## | | | | | | | [60] tractID > 0.28571
## | | | | | | | [61] tractID <= 0.29464: 1.571 (n = 6917, err
= 3166.4)
## | | | | | | | [62] tractID > 0.29464: 1.287 (n = 4408, err =
1476.8)
## | | | | | | | [63] tractID > 0.30357
## | | | | | | | [64] tractID <= 0.3125: 2.446 (n = 7888, err = 6497.7)
## | | | | | | | [65] tractID > 0.3125: 2.053 (n = 36890, err =
31713.4)
## | | | | | | | [66] tractID > 0.35714
## | | | | | | | [67] tractID <= 0.58036
## | | | | | | | [68] tractID <= 0.50893
## | | | | | | | [69] tractID <= 0.47321
## | | | | | | | [70] tractID <= 0.41964
## | | | | | | | [71] tractID <= 0.39286
## | | | | | | | [72] tractID <= 0.375
## | | | | | | | [73] tractID <= 0.36607: 1.180 (n
= 5357, err = 1430.3)
## | | | | | | | [74] tractID > 0.36607: 1.330 (n =
5919, err = 2038.0)
## | | | | | | | [75] tractID > 0.375
## | | | | | | | [76] tractID <= 0.38393: 1.168 (n
= 4912, err = 1255.6)
## | | | | | | | [77] tractID > 0.38393: 1.078 (n =
4452, err = 856.5)

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## | | | | | | | | | [78] tractID > 0.39286
## | | | | | | | | | [79] tractID <= 0.40179: 1.806 (n =
6879, err = 3600.1)
## | | | | | | | | | [80] tractID > 0.40179
## | | | | | | | | | [81] tractID <= 0.41071: 1.064 (n
= 4928, err = 905.9)
## | | | | | | | | | [82] tractID > 0.41071: 1.472 (n =
5839, err = 2575.2)
## | | | | | | | | | [83] tractID > 0.41964
## | | | | | | | | | [84] tractID <= 0.46429: 0.708 (n = 4005,
err = 245.7)
## | | | | | | | | | [85] tractID > 0.46429: 0.926 (n = 1902,
err = 293.3)
## | | | | | | | | | [86] tractID > 0.47321
## | | | | | | | | | [87] tractID <= 0.48214: 1.641 (n = 6396, err
= 3632.8)
## | | | | | | | | | [88] tractID > 0.48214
## | | | | | | | | | [89] tractID <= 0.49107: 1.323 (n = 5876,
err = 1984.7)
## | | | | | | | | | [90] tractID > 0.49107
## | | | | | | | | | [91] tractID <= 0.5: 1.460 (n = 6287,
err = 2632.6)
## | | | | | | | | | [92] tractID > 0.5: 1.488 (n = 6516,
err = 2794.4)
## | | | | | | | | | [93] tractID > 0.50893
## | | | | | | | | | [94] tractID <= 0.51786: 1.096 (n = 4833, err =
1267.3)
## | | | | | | | | | [95] tractID > 0.51786
## | | | | | | | | | [96] tractID <= 0.55357
## | | | | | | | | | [97] tractID <= 0.52679: 0.939 (n = 3820,
err = 689.2)
## | | | | | | | | | [98] tractID > 0.52679
## | | | | | | | | | [99] tractID <= 0.54464
## | | | | | | | | | [100] tractID <= 0.53571: 0.866 (n
= 3088, err = 498.5)
## | | | | | | | | | [101] tractID > 0.53571: 0.757 (n
= 354, err = 38.8)
## | | | | | | | | | [102] tractID > 0.54464: 0.895 (n =
2857, err = 570.2)
## | | | | | | | | | [103] tractID > 0.55357: 0.700 (n = 2811, err
= 226.1)
## | | | | | | | | | [104] tractID > 0.58036
## | | | | | | | | | [105] tractID <= 0.64286
## | | | | | | | | | [106] tractID <= 0.61607
## | | | | | | | | | [107] tractID <= 0.59821
## | | | | | | | | | [108] tractID <= 0.58929: 2.004 (n = 7138,
err = 6154.8)
## | | | | | | | | | [109] tractID > 0.58929: 1.827 (n = 6454,
err = 4597.0)
## | | | | | | | | | [110] tractID > 0.59821

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## | | | | | | | | [111] tractID <= 0.60714: 0.650 (n = 66,
err = 4.1)
## | | | | | | | | [112] tractID > 0.60714: 1.259 (n = 4953,
err = 1849.4)
## | | | | | | | | [113] tractID > 0.61607
## | | | | | | | | [114] tractID <= 0.63393
## | | | | | | | | [115] tractID <= 0.625: 2.191 (n = 7571,
err = 6356.5)
## | | | | | | | | [116] tractID > 0.625: 2.487 (n = 7733,
err = 9309.9)
## | | | | | | | | [117] tractID > 0.63393: 1.911 (n = 7029, err
= 5374.3)
## | | | | | | | | [118] tractID > 0.64286
## | | | | | | | | [119] tractID <= 0.66071
## | | | | | | | | [120] tractID <= 0.65179: 0.666 (n = 312, err
= 26.6)
## | | | | | | | | [121] tractID > 0.65179: 0.711 (n = 1158, err
= 124.2)
## | | | | | | | | [122] tractID > 0.66071
## | | | | | | | | [123] tractID <= 0.67857
## | | | | | | | | [124] tractID <= 0.66964: 1.417 (n = 6095,
err = 2261.9)
## | | | | | | | | [125] tractID > 0.66964: 1.443 (n = 6362,
err = 2517.9)
## | | | | | | | | [126] tractID > 0.67857: 1.336 (n = 6056, err
= 2419.6)
## | | [127] tractID > 0.6875
## | | | [128] tractID <= 0.82143
## | | | [129] tractID <= 0.80357
## | | | [130] tractID <= 0.71429
## | | | [131] tractID <= 0.69643: 1.102 (n = 5066, err =
1647.9)
## | | | [132] tractID > 0.69643
## | | | [133] tractID <= 0.70536: 0.956 (n = 4225, err =
763.4)
## | | | [134] tractID > 0.70536: 0.859 (n = 2345, err =
370.5)
## | | | [135] tractID > 0.71429
## | | | [136] tractID <= 0.79464: 0.527 (n = 3036, err =
474.0)
## | | | [137] tractID > 0.79464: 0.700 (n = 1388, err = 197.2)
## | | | [138] tractID > 0.80357
## | | | [139] tractID <= 0.8125: 1.436 (n = 5942, err = 3034.1)
## | | | [140] tractID > 0.8125: 0.962 (n = 4507, err = 942.2)
## | | | [141] tractID > 0.82143
## | | | [142] tractID <= 0.85714
## | | | [143] tractID <= 0.84821
## | | | [144] tractID <= 0.83929
## | | | [145] tractID <= 0.83036: 0.815 (n = 3196, err =
535.6)

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## | | | | | [146] tractID > 0.83036: 0.547 (n = 885, err =
134.9)
## | | | | | [147] tractID > 0.83929: 0.875 (n = 2471, err = 447.5)
## | | | | | [148] tractID > 0.84821: 0.674 (n = 1716, err = 215.5)
## | | | | | [149] tractID > 0.85714
## | | | | | [150] tractID <= 0.86607: 1.043 (n = 4766, err = 1441.5)
## | | | | | [151] tractID > 0.86607
## | | | | | [152] tractID <= 0.97321
## | | | | | [153] tractID <= 0.91071: 0.557 (n = 454, err =
56.2)
## | | | | | [154] tractID > 0.91071: 0.672 (n = 1165, err =
132.2)
## | | | | | [155] tractID > 0.97321
## | | | | | [156] tractID <= 0.98214: 0.870 (n = 906, err =
149.1)
## | | | | | [157] tractID > 0.98214
## | | | | | [158] tractID <= 0.99107: 0.602 (n = 83, err =
9.6)
## | | | | | [159] tractID > 0.99107: 0.686 (n = 451, err =
51.6)
##
## Number of inner nodes: 79
## Number of terminal nodes: 80

model = ctree(cnt ~ tractID, data = hour_2013 )

print(model)

##
## Model formula:
## cnt ~ tractID
##
## Fitted party:
## [1] root
## | [2] tractID <= 0.30357
## | | [3] tractID <= 0: 10.541 (n = 6837, err = 750309.7)
## | | [4] tractID > 0
## | | | [5] tractID <= 0.20536
## | | | [6] tractID <= 0.125
## | | | [7] tractID <= 0.08036: 2.356 (n = 35200, err =
122820.6)
## | | | | [8] tractID > 0.08036
## | | | | [9] tractID <= 0.11607
## | | | | [10] tractID <= 0.09821
## | | | | [11] tractID <= 0.08929: 1.616 (n = 1003,
err = 993.2)
## | | | | [12] tractID > 0.08929: 1.825 (n = 2087,
err = 4619.2)
## | | | | [13] tractID > 0.09821
## | | | | [14] tractID <= 0.10714: 1.283 (n = 903,

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err = 515.4)
## | | | | | | | | [15] tractID > 0.10714: 1.523 (n = 2239,
err = 1832.6)
## | | | | | | | | [16] tractID > 0.11607: 1.919 (n = 2960, err =
7072.5)
## | | | | | | | | [17] tractID > 0.125
## | | | | | | | | [18] tractID <= 0.16071
## | | | | | | | | [19] tractID <= 0.15179
## | | | | | | | | [20] tractID <= 0.13393: 4.353 (n = 6633, err
= 95897.1)
## | | | | | | | | [21] tractID > 0.13393
## | | | | | | | | [22] tractID <= 0.14286: 3.387 (n = 5889,
err = 42904.8)
## | | | | | | | | [23] tractID > 0.14286: 3.844 (n = 6426,
err = 53827.8)
## | | | | | | | | [24] tractID > 0.15179: 5.998 (n = 7005, err =
194450.0)
## | | | | | | | | [25] tractID > 0.16071
## | | | | | | | | [26] tractID <= 0.19643
## | | | | | | | | [27] tractID <= 0.1875
## | | | | | | | | [28] tractID <= 0.16964: 2.449 (n = 4387,
err = 21205.2)
## | | | | | | | | [29] tractID > 0.16964
## | | | | | | | | [30] tractID <= 0.17857: 2.910 (n =
5664, err = 29576.4)
## | | | | | | | | [31] tractID > 0.17857: 2.532 (n =
3876, err = 21027.0)
## | | | | | | | | [32] tractID > 0.1875: 1.810 (n = 633, err =
1177.3)
## | | | | | | | | [33] tractID > 0.19643: 3.677 (n = 3994, err =
39681.4)
## | | | | | | | | [34] tractID > 0.20536
## | | | | | | | | [35] tractID <= 0.23214
## | | | | | | | | [36] tractID <= 0.22321
## | | | | | | | | [37] tractID <= 0.21429: 8.078 (n = 7429, err =
402719.0)
## | | | | | | | | [38] tractID > 0.21429: 4.852 (n = 6881, err =
90817.3)
## | | | | | | | | [39] tractID > 0.22321: 8.926 (n = 7480, err =
390881.3)
## | | | | | | | | [40] tractID > 0.23214
## | | | | | | | | [41] tractID <= 0.25893
## | | | | | | | | [42] tractID <= 0.25
## | | | | | | | | [43] tractID <= 0.24107: 5.170 (n = 6893, err
= 117760.0)
## | | | | | | | | [44] tractID > 0.24107: 4.864 (n = 6761, err =
103665.5)
## | | | | | | | | [45] tractID > 0.25: 6.699 (n = 7295, err =
265526.1)
## | | | | | | | | [46] tractID > 0.25893

```

```

## | | | | | | | [47] tractID <= 0.28571
## | | | | | | | [48] tractID <= 0.27679
## | | | | | | | [49] tractID <= 0.26786: 3.036 (n = 5243,
err = 32013.1)
## | | | | | | | [50] tractID > 0.26786: 4.139 (n = 6242,
err = 68253.9)
## | | | | | | | [51] tractID > 0.27679: 2.494 (n = 2835, err =
12214.6)
## | | | | | | | [52] tractID > 0.28571
## | | | | | | | [53] tractID <= 0.29464: 5.578 (n = 6917, err
= 177060.9)
## | | | | | | | [54] tractID > 0.29464: 3.693 (n = 4408, err =
38525.3)
## | [55] tractID > 0.30357
## | [56] tractID <= 0.35714
## | | [57] tractID <= 0.34821: 14.382 (n = 37836, err = 7857486.6)
## | | [58] tractID > 0.34821: 31.858 (n = 6942, err = 9448557.2)
## | | [59] tractID > 0.35714: 5.761 (n = 190560, err = 16135348.3)
##
## Number of inner nodes: 29
## Number of terminal nodes: 30

#plot(as.simpleparty(model))

library(partykit)
library(grid)

model = ctree(casual ~ hr, data = hour_2013 )

print(model)

##
## Model formula:
## casual ~ hr
##
## Fitted party:
## [1] root
## | [2] hr <= 1.35907
## | | [3] hr <= 1.18919
## | | | [4] hr <= 0.50965
## | | | | [5] hr <= 0: 0.236 (n = 9997, err = 2229.0)
## | | | | [6] hr > 0: 0.203 (n = 15251, err = 2634.7)
## | | | | [7] hr > 0.50965
## | | | | [8] hr <= 1.01931: 0.084 (n = 25626, err = 1665.9)
## | | | | [9] hr > 1.01931: 0.163 (n = 20696, err = 2681.6)
## | | | [10] hr > 1.18919: 0.250 (n = 23234, err = 5102.5)
## | | [11] hr > 1.35907
## | | [12] hr <= 3.05792
## | | | [13] hr <= 1.52896: 0.336 (n = 21814, err = 7921.9)
## | | | [14] hr > 1.52896

```

```

## | | | | | [15] hr <= 2.71815
## | | | | | [16] hr <= 1.69884: 0.480 (n = 19995, err = 11186.0)
## | | | | | [17] hr > 1.69884
## | | | | | [18] hr <= 2.54826
## | | | | | [19] hr <= 2.03861: 0.553 (n = 41790, err =
27635.5)
## | | | | | [20] hr > 2.03861: 0.569 (n = 63312, err =
46008.5)
## | | | | | [21] hr > 2.54826: 0.520 (n = 22175, err =
15502.4)
## | | | | | [22] hr > 2.71815
## | | | | | [23] hr <= 2.88803: 0.497 (n = 23257, err = 15423.8)
## | | | | | [24] hr > 2.88803: 0.461 (n = 23191, err = 13279.2)
## | | | [25] hr > 3.05792
## | | | [26] hr <= 3.39769
## | | | [27] hr <= 3.2278: 0.418 (n = 21852, err = 11055.6)
## | | | [28] hr > 3.2278: 0.368 (n = 19874, err = 8628.7)
## | | | [29] hr > 3.39769
## | | | [30] hr <= 3.73745
## | | | [31] hr <= 3.56757: 0.338 (n = 17915, err = 6907.1)
## | | | [32] hr > 3.56757: 0.304 (n = 15918, err = 5360.0)
## | | | [33] hr > 3.73745: 0.256 (n = 13561, err = 3537.5)
##
## Number of inner nodes:    16
## Number of terminal nodes: 17

model = ctree(registered ~ hr, data = hour_2013 )

print(model)

##
## Model formula:
## registered ~ hr
##
## Fitted party:
## [1] root
## | [2] hr <= 1.01931
## | | [3] hr <= 0.84942
## | | | [4] hr <= 0.33977
## | | | [5] hr <= 0: 1.032 (n = 9997, err = 2921.5)
## | | | [6] hr > 0
## | | | [7] hr <= 0.16988: 0.949 (n = 7083, err = 1881.8)
## | | | [8] hr > 0.16988: 0.891 (n = 5043, err = 1276.0)
## | | | [9] hr > 0.33977
## | | | [10] hr <= 0.67954
## | | | [11] hr <= 0.50965: 0.762 (n = 3125, err = 491.7)
## | | | [12] hr > 0.50965: 0.654 (n = 2615, err = 211.0)
## | | | [13] hr > 0.67954: 0.830 (n = 8034, err = 854.7)
## | | | [14] hr > 0.84942: 1.151 (n = 14977, err = 4590.7)
## | | [15] hr > 1.01931

```

```

## | | [16] hr <= 3.39769
## | | [17] hr <= 2.71815
## | | [18] hr <= 1.35907
## | | [19] hr <= 1.18919: 1.560 (n = 20696, err = 13354.3)
## | | [20] hr > 1.18919: 1.819 (n = 23234, err = 18835.5)
## | | [21] hr > 1.35907
## | | [22] hr <= 2.54826
## | | [23] hr <= 1.52896: 1.466 (n = 21814, err =
11480.5)
## | | [24] hr > 1.52896
## | | [25] hr <= 1.86873
## | | [26] hr <= 1.69884: 1.286 (n = 19995, err
= 8930.8)
## | | [27] hr > 1.69884: 1.342 (n = 20441, err =
10680.4)
## | | [28] hr > 1.86873: 1.415 (n = 84661, err =
50034.1)
## | | [29] hr > 2.54826: 1.555 (n = 22175, err = 16055.6)
## | | [30] hr > 2.71815
## | | [31] hr <= 3.2278
## | | [32] hr <= 3.05792: 1.757 (n = 46448, err = 43867.6)
## | | [33] hr > 3.05792: 1.637 (n = 21852, err = 15521.3)
## | | [34] hr > 3.2278: 1.487 (n = 19874, err = 11841.5)
## | | [35] hr > 3.39769
## | | [36] hr <= 3.73745
## | | [37] hr <= 3.56757: 1.396 (n = 17915, err = 9328.2)
## | | [38] hr > 3.56757: 1.297 (n = 15918, err = 6997.8)
## | | [39] hr > 3.73745: 1.158 (n = 13561, err = 4653.6)
##
## Number of inner nodes: 19
## Number of terminal nodes: 20

model = ctree(cnt ~ hr, data = hour_2013 )

print(model)

##
## Model formula:
## cnt ~ hr
##
## Fitted party:
## [1] root
## | [2] hr <= 1.01931
## | | [3] hr <= 0.84942
## | | | [4] hr <= 0.33977
## | | | [5] hr <= 0: 2.803 (n = 9997, err = 85720.4)
## | | | [6] hr > 0
## | | | [7] hr <= 0.16988: 2.395 (n = 7083, err = 42561.3)
## | | | [8] hr > 0.16988: 2.207 (n = 5043, err = 24936.7)
## | | [9] hr > 0.33977

```

```
## | | | | [10] hr <= 0.50965: 1.673 (n = 3125, err = 5437.4)
## | | | | [11] hr > 0.50965
## | | | | [12] hr <= 0.67954: 1.191 (n = 2615, err = 755.8)
## | | | | [13] hr > 0.67954: 1.524 (n = 8034, err = 6521.7)
## | | [14] hr > 0.84942: 2.892 (n = 14977, err = 103124.3)
## | [15] hr > 1.01931: 7.067 (n = 348584, err = 43787176.0)
##
## Number of inner nodes: 7
## Number of terminal nodes: 8

library(party)

## Warning: package 'party' was built under R version 3.4.2

## Loading required package: mvtnorm

## Loading required package: modeltools

## Loading required package: stats4

## Loading required package: strucchange

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
## as.Date, as.Date.numeric

## Loading required package: sandwich

##
## Attaching package: 'party'

## The following objects are masked from 'package:partykit':
##
## cforest, ctree, ctree_control, edge_simple, mob, mob_control,
## node_barplot, node_bivplot, node_boxplot, node_inner,
## node_surv, node_terminal

library(grid)

model = ctree(casual ~ mth, data = hour_2013 )

print(model)

##
## Conditional inference tree with 7 terminal nodes
##
## Response: casual
## Input: mth
```

```
## Number of observations: 399458
##
## 1) mth <= 2; criterion = 1, statistic = 27.619
## 2) mth <= 1; criterion = 1, statistic = 131.729
## 3)* weights = 27071
## 2) mth > 1
## 4)* weights = 24476
## 1) mth > 2
## 5) mth <= 10; criterion = 1, statistic = 2516.534
## 6) mth <= 3; criterion = 0.994, statistic = 7.674
## 7)* weights = 28675
## 6) mth > 3
## 8) mth <= 9; criterion = 1, statistic = 366.427
## 9)* weights = 216738
## 8) mth > 9
## 10)* weights = 37866
## 5) mth > 10
## 11) mth <= 11; criterion = 1, statistic = 460.016
## 12)* weights = 34209
## 11) mth > 11
## 13)* weights = 30423
```

```
model = ctree(registered ~ mth, data = hour_2013 )
```

```
print(model)
```

```
##
## Conditional inference tree with 4 terminal nodes
##
## Response: registered
## Input: mth
## Number of observations: 399458
##
## 1) mth <= 3; criterion = 1, statistic = 166.548
## 2) mth <= 2; criterion = 1, statistic = 21.387
## 3)* weights = 51547
## 2) mth > 2
## 4)* weights = 28675
## 1) mth > 3
## 5) mth <= 11; criterion = 1, statistic = 286.971
## 6)* weights = 288813
## 5) mth > 11
## 7)* weights = 30423
```

```
model = ctree(cnt ~ mth, data = hour_2013 )
```

```
print(model)
```

```
##
## Conditional inference tree with 6 terminal nodes
##
```



```
## Response:  cnt
## Input:  mth
## Number of observations:  399458
##
## 1) mth <= 3; criterion = 1, statistic = 120.197
## 2) mth <= 2; criterion = 1, statistic = 192.863
## 3) mth <= 1; criterion = 0.96, statistic = 4.232
## 4)* weights = 27071
## 3) mth > 1
## 5)* weights = 24476
## 2) mth > 2
## 6)* weights = 28675
## 1) mth > 3
## 7) mth <= 10; criterion = 1, statistic = 1044.76
## 8)* weights = 254604
## 7) mth > 10
## 9) mth <= 11; criterion = 1, statistic = 343.136
## 10)* weights = 34209
## 9) mth > 11
## 11)* weights = 30423

library(party)
library(grid)

model = ctree(casual ~ temp, data = hour_2013 )

print(model)

##
## Conditional inference tree with 22 terminal nodes
##
## Response:  casual
## Input:  temp
## Number of observations:  399458
##
## 1) temp <= 1.170369; criterion = 1, statistic = 21449.617
## 2) temp <= 0.759158; criterion = 1, statistic = 3255.359
## 3) temp <= 0.3163158; criterion = 1, statistic = 946.066
## 4) temp <= -0.2952281; criterion = 1, statistic = 172.516
## 5) temp <= -0.5271931; criterion = 0.999, statistic = 10.55
## 6)* weights = 1915
## 5) temp > -0.5271931
## 7)* weights = 2482
## 4) temp > -0.2952281
## 8) temp <= 0.1159825; criterion = 1, statistic = 20.646
## 9)* weights = 17624
## 8) temp > 0.1159825
## 10)* weights = 16773
## 3) temp > 0.3163158
## 11) temp <= 0.4639299; criterion = 1, statistic = 69.262
```

```
##      12)* weights = 18555
##      11) temp > 0.4639299
##      13) temp <= 0.5904562; criterion = 0.97, statistic = 4.697
##      14)* weights = 12919
##      13) temp > 0.5904562
##      15)* weights = 20221
## 2) temp > 0.759158
##      16) temp <= 0.9384037; criterion = 1, statistic = 127.211
##      17) temp <= 0.8751405; criterion = 0.997, statistic = 8.982
##      18)* weights = 11275
##      17) temp > 0.8751405
##      19)* weights = 6108
##      16) temp > 0.9384037
##      20)* weights = 22854
## 1) temp > 1.170369
##      21) temp <= 2.699229; criterion = 1, statistic = 3608.468
##      22) temp <= 1.876807; criterion = 1, statistic = 431.72
##      23) temp <= 1.581579; criterion = 1, statistic = 37.4
##      24)* weights = 42104
##      23) temp > 1.581579
##      25) temp <= 1.760825; criterion = 0.999, statistic = 10.229
##      26)* weights = 20678
##      25) temp > 1.760825
##      27)* weights = 14445
##      22) temp > 1.876807
##      28) temp <= 2.572702; criterion = 0.965, statistic = 4.47
##      29) temp <= 2.319649; criterion = 1, statistic = 14.891
##      30)* weights = 48789
##      29) temp > 2.319649
##      31)* weights = 44812
##      28) temp > 2.572702
##      32)* weights = 18807
##      21) temp > 2.699229
##      33) temp <= 2.86793; criterion = 1, statistic = 68.647
##      34) temp <= 2.815211; criterion = 1, statistic = 20.005
##      35)* weights = 18166
##      34) temp > 2.815211
##      36)* weights = 8325
##      33) temp > 2.86793
##      37) temp <= 3.511106; criterion = 0.98, statistic = 5.387
##      38) temp <= 3.226422; criterion = 0.965, statistic = 4.449
##      39)* weights = 37646
##      38) temp > 3.226422
##      40)* weights = 12666
##      37) temp > 3.511106
##      41) temp <= 3.574369; criterion = 0.99, statistic = 6.709
##      42)* weights = 940
##      41) temp > 3.574369
##      43)* weights = 1354
```

```
model = ctree(registered ~ temp, data = hour_2013 )

print(model)

##
## Conditional inference tree with 10 terminal nodes
##
## Response: registered
## Input: temp
## Number of observations: 399458
##
## 1) temp <= 0.8224212; criterion = 1, statistic = 4767.385
## 2) temp <= 0.2952281; criterion = 1, statistic = 766.937
## 3) temp <= 0; criterion = 1, statistic = 68.748
## 4) temp <= -0.1159825; criterion = 1, statistic = 20.142
## 5)* weights = 8759
## 4) temp > -0.1159825
## 6)* weights = 4860
## 3) temp > 0
## 7)* weights = 24975
## 2) temp > 0.2952281
## 8) temp <= 0.4639299; criterion = 1, statistic = 83.211
## 9) temp <= 0.3479474; criterion = 0.999, statistic = 10.405
## 10)* weights = 6519
## 9) temp > 0.3479474
## 11)* weights = 12236
## 8) temp > 0.4639299
## 12)* weights = 37981
## 1) temp > 0.8224212
## 13) temp <= 2.635965; criterion = 1, statistic = 948.456
## 14) temp <= 1.402334; criterion = 1, statistic = 119.561
## 15)* weights = 57437
## 14) temp > 1.402334
## 16) temp <= 2.45672; criterion = 0.992, statistic = 7.06
## 17)* weights = 132110
## 16) temp > 2.45672
## 18)* weights = 26335
## 13) temp > 2.635965
## 19)* weights = 88246

model = ctree(cnt ~ temp, data = hour_2013 )

print(model)

##
## Conditional inference tree with 15 terminal nodes
##
## Response: cnt
## Input: temp
## Number of observations: 399458
```

```
##
## 1) temp <= 1.159825; criterion = 1, statistic = 7789.468
## 2) temp <= 0.4639299; criterion = 1, statistic = 1486.247
## 3) temp <= 0.1159825; criterion = 1, statistic = 237.439
## 4) temp <= 0; criterion = 0.986, statistic = 6.02
## 5)* weights = 13619
## 4) temp > 0
## 6) temp <= 0.1054386; criterion = 0.963, statistic = 4.341
## 7) temp <= 0.06326317; criterion = 1, statistic = 14.776
## 8)* weights = 3492
## 7) temp > 0.06326317
## 9)* weights = 103
## 6) temp > 0.1054386
## 10)* weights = 4807
## 3) temp > 0.1159825
## 11)* weights = 35328
## 2) temp > 0.4639299
## 12) temp <= 0.8224212; criterion = 1, statistic = 112.662
## 13) temp <= 0.6431755; criterion = 0.989, statistic = 6.539
## 14)* weights = 19238
## 13) temp > 0.6431755
## 15)* weights = 18743
## 12) temp > 0.8224212
## 16)* weights = 29267
## 1) temp > 1.159825
## 17) temp <= 2.635965; criterion = 1, statistic = 1402.144
## 18) temp <= 1.518316; criterion = 1, statistic = 118.238
## 19)* weights = 40927
## 18) temp > 1.518316
## 20) temp <= 1.897895; criterion = 0.998, statistic = 9.936
## 21)* weights = 42547
## 20) temp > 1.897895
## 22)* weights = 103141
## 17) temp > 2.635965
## 23) temp <= 2.86793; criterion = 1, statistic = 48.29
## 24) temp <= 2.751948; criterion = 0.979, statistic = 5.343
## 25)* weights = 17886
## 24) temp > 2.751948
## 26)* weights = 17754
## 23) temp > 2.86793
## 27) temp <= 3.511106; criterion = 0.971, statistic = 4.788
## 28)* weights = 50312
## 27) temp > 3.511106
## 29)* weights = 2294
```