Kaggle

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Saturday, August 23, 2014

Data Fields

datetime - hourly date + timestamp
season - 1 = spring, 2 = summer, 3 = fall, 4 = winter holiday - whether the day is considered a holiday workingday - whether the day is neither a weekend nor holiday weather - 1: Clear, Few clouds, Partly cloudy, Partly cloudy 2: Mist + Cloudy, Mist + Broken clouds, Mist + Few clouds, Mist 3: Light Snow, Light Rain + Thunderstorm + Scattered clouds, Light Rain + Scattered clouds 4: Heavy Rain + Ice Pallets + Thunderstorm + Mist, Snow + Fog temp - temperature in Celsius atemp - "feels like" temperature in Celsius humidity - relative humidity windspeed - wind speed casual - number of non-registered user rentals initiated registered - number of registered user rentals initiated count - number of total rentals

```
bikejan <- read.csv("bikejan.csv")
bikejan$datetime <- as.POSIXlt(as.character(bikejan$datetime))
str(bikejan)
```

```
## 'data.frame':    456 obs. of  18 variables:
##  $ datetime  : POSIXlt, format: "0001-01-11 00:00:00" "0001-01-11 01:00:00" ...
##  $ season    : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ holiday   : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ workingday: int  0 0 0 0 0 0 0 0 0 0 ...
##  $ weather   : int  1 1 1 1 1 2 1 1 1 1 ...
##  $ temp      : num  9.84 9.02 9.02 9.84 9.84 ...
##  $ atemp     : num  14.4 13.6 13.6 14.4 14.4 ...
##  $ humidity  : num  81 80 80 75 75 75 80 86 75 76 ...
##  $ windspeed : num  0 0 0 0 0 ...
##  $ casual    : int  3 8 5 3 0 0 2 1 1 8 ...
##  $ registered: int  13 32 27 10 1 1 0 2 7 6 ...
##  $ count     : int  16 40 32 13 1 1 2 3 8 14 ...
##  $ year      : int  2011 2011 2011 2011 2011 2011 2011 2011 2011 2011 ...
##  $ month     : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ date      : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ hour      : int  0 1 2 3 4 5 6 7 8 9 ...
##  $ day       : int  7 7 7 7 7 7 7 7 7 7 ...
##  $ flag      : int  1 1 1 1 1 1 1 1 1 1 ...
```

```
summary(bikejan)
```

```
##     datetime                       season     holiday
##  Min.   :0001-01-11 00:00:00   Min.   :1   Min.   :0.0000
##  1st Qu.:0001-05-11 17:45:00   1st Qu.:1   1st Qu.:0.0000
##  Median :0001-10-11 11:30:00   Median :1   Median :0.0000
##  Mean   :0006-11-05 00:07:54   Mean   :1   Mean   :0.0526
##  3rd Qu.:0015-01-11 05:15:00   3rd Qu.:1   3rd Qu.:0.0000
##  Max.   :0019-01-11 23:00:00   Max.   :1   Max.   :1.0000
##
##    workingday       weather          temp           atemp
```

```
##  Min.   :0.000   Min.   :1.00   Min.   : 3.28   Min.   : 3.03
##  1st Qu.:0.000   1st Qu.:1.00   1st Qu.: 6.56   1st Qu.: 7.96
##  Median :1.000   Median :1.00   Median : 8.20   Median : 9.85
##  Mean   :0.632   Mean   :1.47   Mean   : 8.57   Mean   :10.66
##  3rd Qu.:1.000   3rd Qu.:2.00   3rd Qu.: 9.84   3rd Qu.:12.88
##  Max.   :1.000   Max.   :3.00   Max.   :18.86   Max.   :22.73
##
##     humidity       windspeed        casual        registered
##  Min.   : 28.0   Min.   : 0.0   Min.   : 0.00   Min.   :  0
##  1st Qu.: 44.0   1st Qu.: 9.0   1st Qu.: 0.00   1st Qu.: 13
##  Median : 53.0   Median :13.0   Median : 2.00   Median : 43
##  Mean   : 57.4   Mean   :13.9   Mean   : 4.66   Mean   : 50
##  3rd Qu.: 69.0   3rd Qu.:19.0   3rd Qu.: 6.00   3rd Qu.: 70
##  Max.   :100.0   Max.   :39.0   Max.   :47.00   Max.   :216
##                                 NA's   :25      NA's   :25
##      count            year          month        date         hour
##  Min.   :  1.0   Min.   :2011   Min.   :1   Min.   : 1   Min.   : 0.00
##  1st Qu.: 12.0   1st Qu.:2011   1st Qu.:1   1st Qu.: 5   1st Qu.: 5.75
##  Median : 44.0   Median :2011   Median :1   Median :10   Median :11.50
##  Mean   : 52.7   Mean   :2011   Mean   :1   Mean   :10   Mean   :11.50
##  3rd Qu.: 77.2   3rd Qu.:2011   3rd Qu.:1   3rd Qu.:15   3rd Qu.:17.25
##  Max.   :219.0   Max.   :2011   Max.   :1   Max.   :19   Max.   :23.00
##
##       day            flag
##  Min.   :1.00   Min.   :-23
##  1st Qu.:3.00   1st Qu.:  1
##  Median :4.00   Median :  1
##  Mean   :4.21   Mean   :  0
##  3rd Qu.:6.00   3rd Qu.:  1
##  Max.   :7.00   Max.   :  1
##
```

```
x <- 1:10
y <- 990:999
```

Univariate Analysis of Categorical Variables

1. Season

```
table(bikejan$season)/24
```

```
##
##  1
## 19
```

2. Holiday

```
table(bikejan$holiday)/24
```

```
##
##  0  1
## 18  1
```

```
bikejan[(bikejan$holiday==1),c(15,17)]
```

```
##     date day
## 385   17   2
## 386   17   2
## 387   17   2
## 388   17   2
## 389   17   2
## 390   17   2
## 391   17   2
## 392   17   2
## 393   17   2
## 394   17   2
## 395   17   2
## 396   17   2
## 397   17   2
## 398   17   2
## 399   17   2
## 400   17   2
## 401   17   2
## 402   17   2
## 403   17   2
## 404   17   2
## 405   17   2
## 406   17   2
## 407   17   2
## 408   17   2
```

3. Working Day

```
table(bikejan$workingday)/24
```

```
##
##  0  1
##  7 12
```

```
table(bikejan$day)/24
```

```
##
## 1 2 3 4 5 6 7
## 2 2 4 2 3 3 3
```

4. Weather

```
table(bikejan$weather)/24
```

```
##
##      1      2      3
## 11.458  6.167  1.375
```

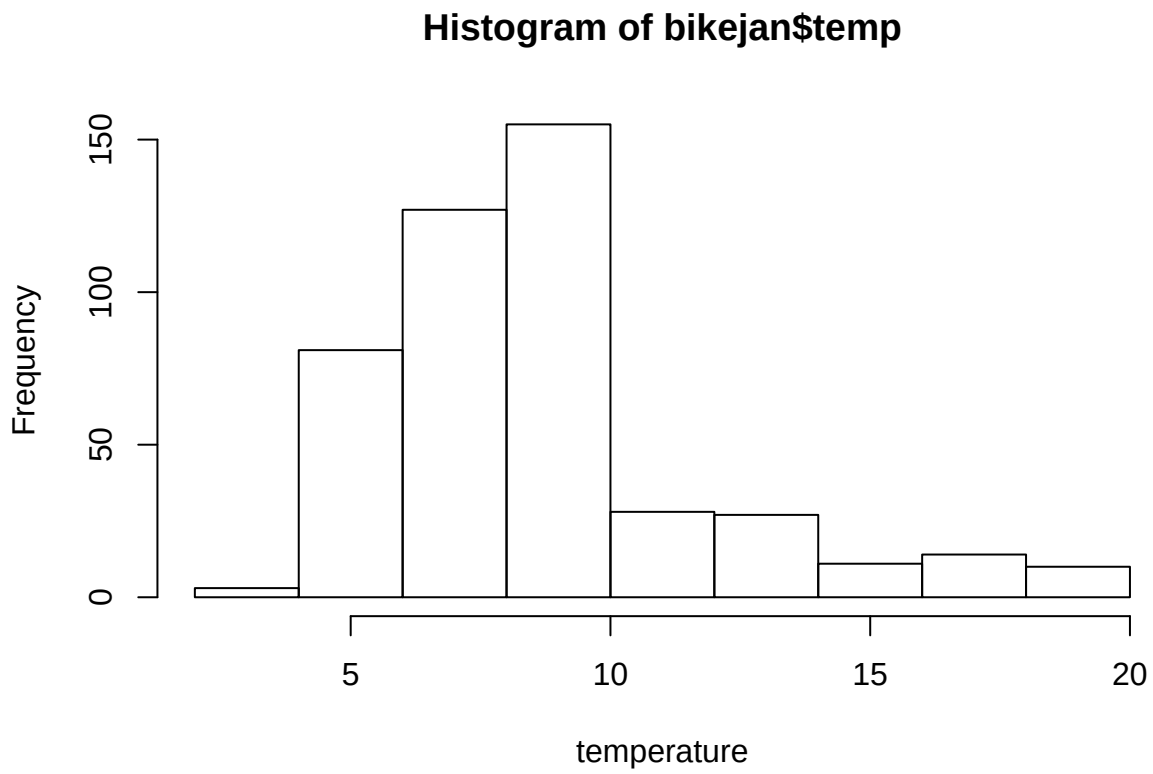
```
table(bikejan$weather)
```

```
##
##   1   2   3
## 275 148  33
```

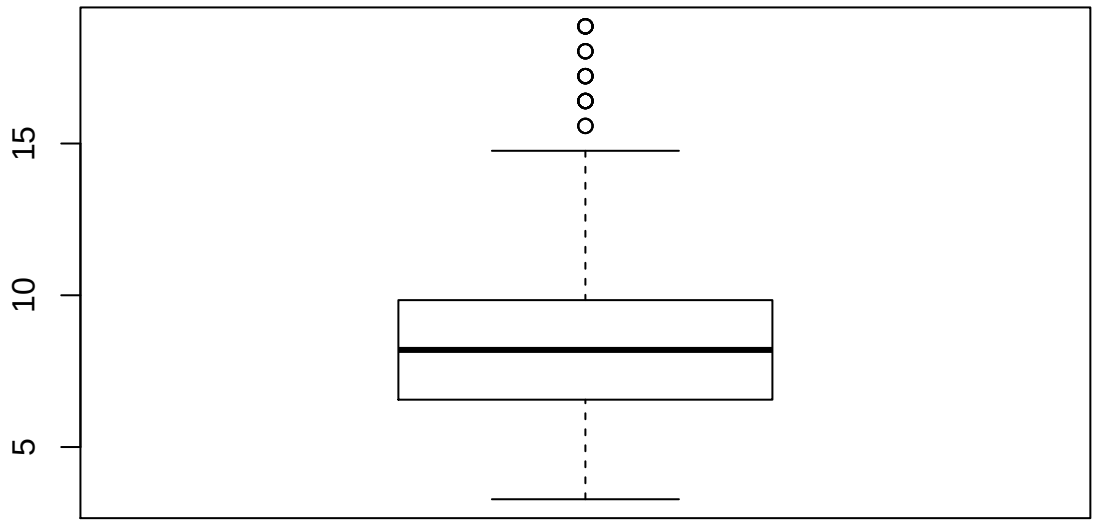
Univariate Analysis for continuous variables

1. temp

```
hist(bikejan$temp,xlab="temperature")
```




```
boxplot(bikejan$temp,xlab="temperature")
```



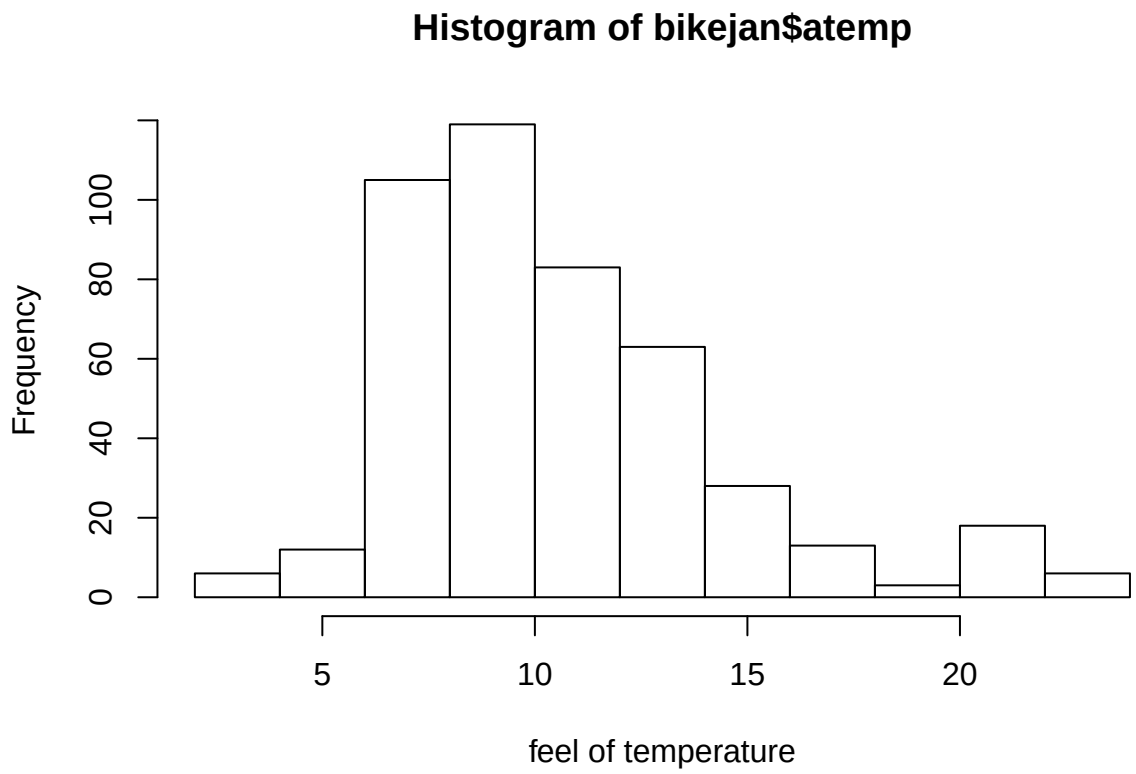
temperature

```
quantile(bikejan$temp,c(x/1000,0.05,0.1,0.2,0.25,0.3,0.4,0.5,0.6,0.7,0.75,0.8,0.9,0.95,0.96,0.97,0.98,0
```

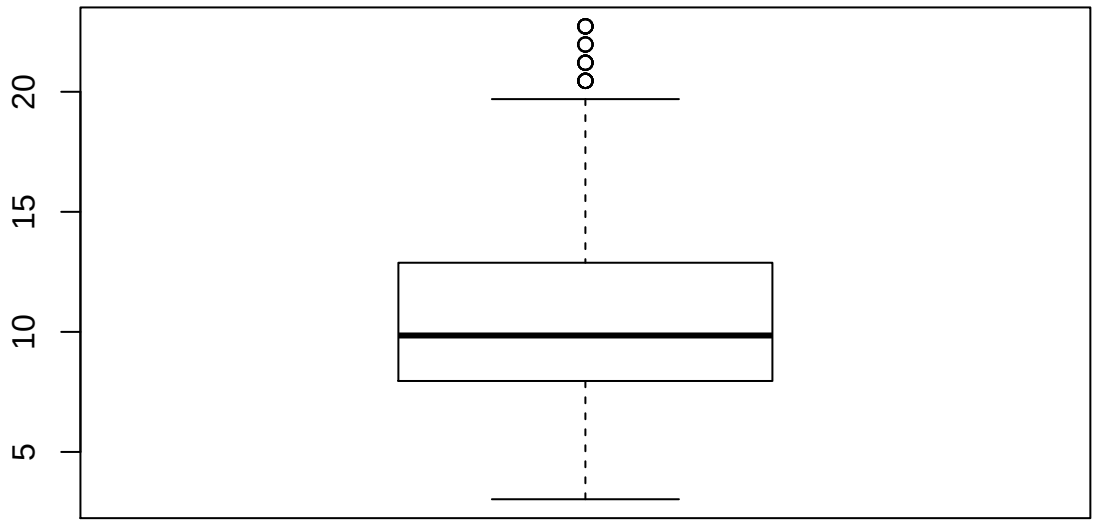
```
##   0.1%   0.2%   0.3%   0.4%   0.5%   0.6%   0.7%   0.8%   0.9%     1%
##  3.280  3.280  3.280  3.280  3.505  3.879  4.100  4.100  4.100  4.100
##     5%    10%    20%    25%    30%    40%    50%    60%    70%    75%
##  4.920  5.740  6.560  6.560  6.560  7.380  8.200  8.200  9.020  9.840
##    80%    90%    95%    96%    97%    98%    99%    99%  99.1%  99.2%
##  9.840 13.120 16.400 16.400 17.220 17.958 18.860 18.860 18.860 18.860
##  99.3%  99.4%  99.5%  99.6%  99.7%  99.8%  99.9%
## 18.860 18.860 18.860 18.860 18.860 18.860 18.860
```

2. atemp

```
hist(bikejan$atemp,xlab="feel of temperature")
```




```
boxplot(bikejan$atemp,xlab="feel of temperature")
```



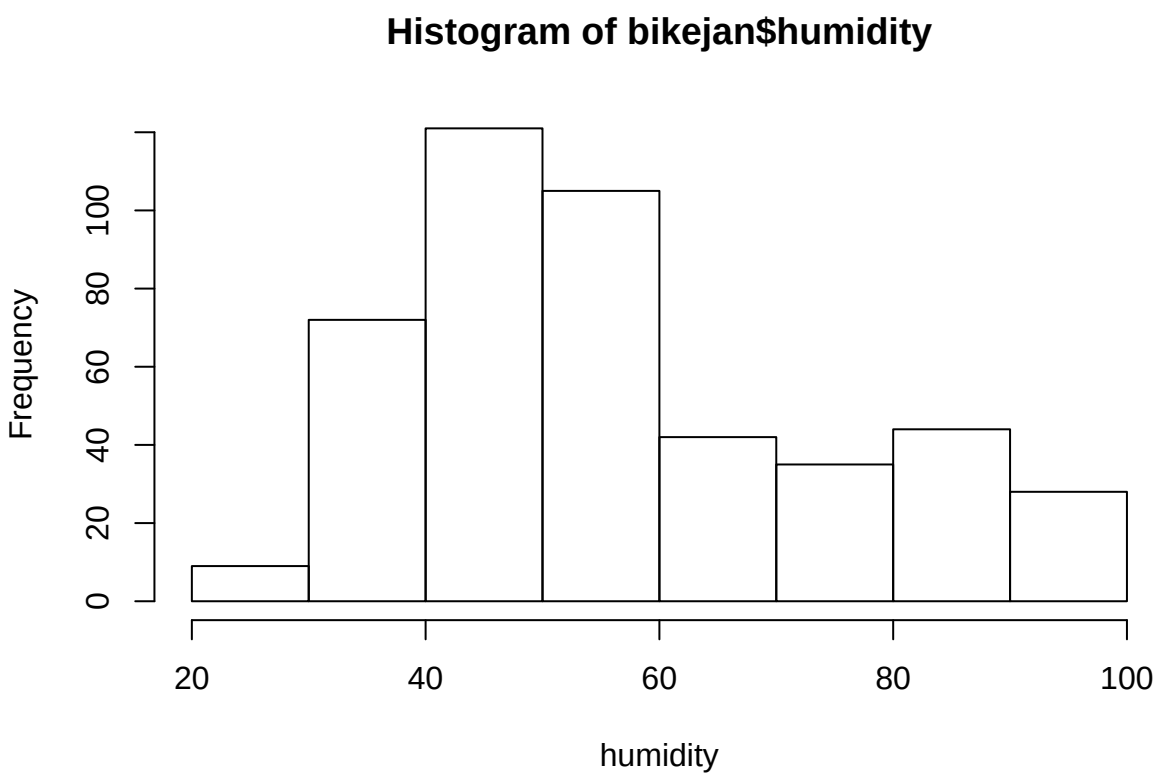
feel of temperature

```
quantile(bikejan$atemp,c(x/1000,0.05,0.1,0.2,0.25,0.3,0.4,0.5,0.6,0.7,0.75,0.8,0.9,0.95,0.96,0.97,0.98,
```

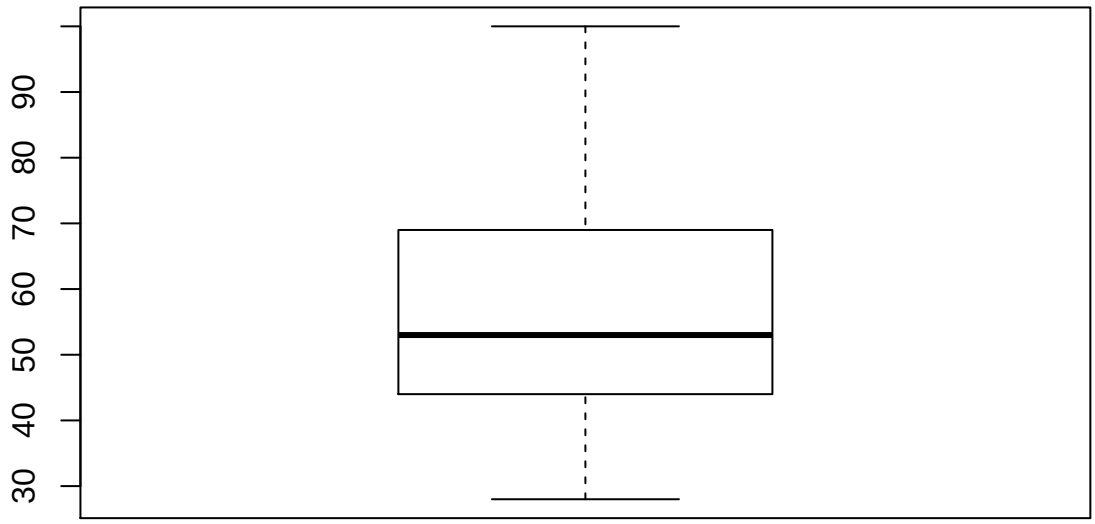
```
##   0.1%   0.2%   0.3%   0.4%   0.5%   0.6%   0.7%   0.8%   0.9%     1%
##  3.030  3.030  3.030  3.030  3.239  3.585  3.790  3.790  3.790  3.790
##     5%    10%    20%    25%    30%    40%    50%    60%    70%    75%
##  6.060  6.060  7.575  7.955  8.335  9.090  9.850 10.605 11.365 12.880
##    80%    90%    95%    96%    97%    98%    99%    99% 99.1% 99.2%
## 12.880 15.150 20.455 20.455 21.210 21.892 22.725 22.725 22.725 22.725
##  99.3%  99.4%  99.5%  99.6%  99.7%  99.8%  99.9%
## 22.725 22.725 22.725 22.725 22.725 22.725 22.725
```

3. humidity

```
hist(bikejan$humidity,xlab="humidity")
```




```
boxplot(bikejan$humidity,xlab="humidity")
```

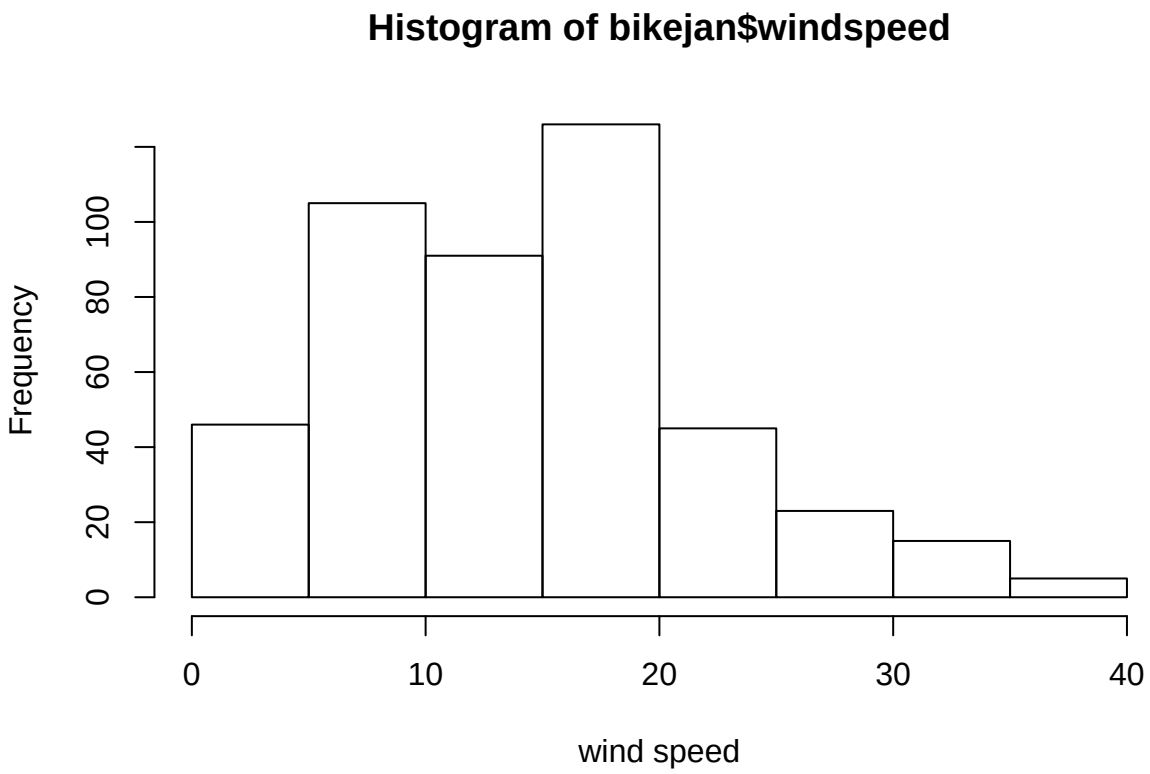



```
quantile(bikejan$humidity,c(x/1000,0.05,0.1,0.2,0.25,0.3,0.4,0.5,0.6,0.7,0.75,0.8,0.9,0.95,0.96,0.97,0.9
```

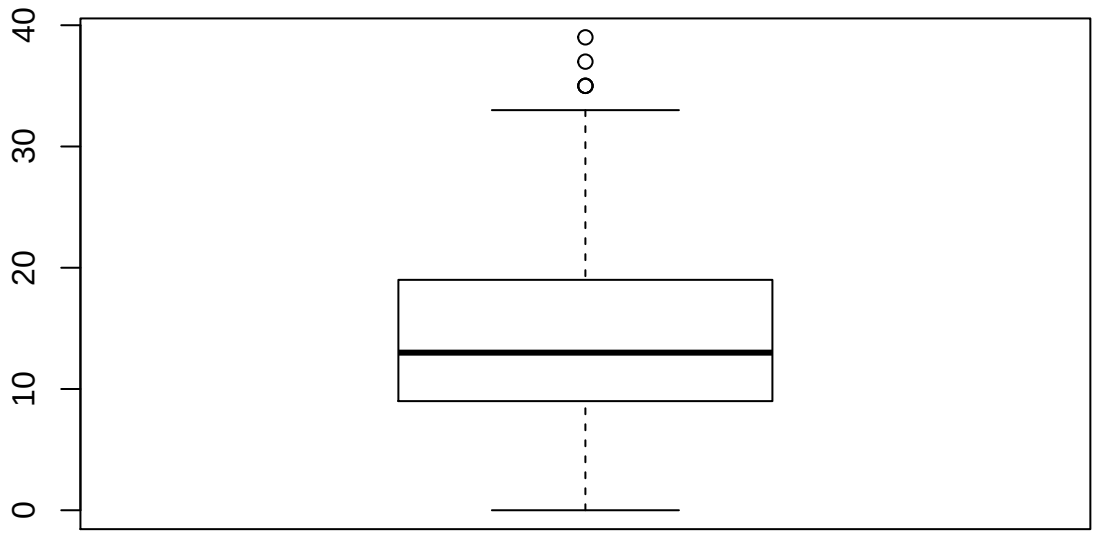
```
##  0.1%  0.2%  0.3%  0.4%  0.5%  0.6%  0.7%  0.8%  0.9%    1%    5%   10%
## 28.00 28.00 28.00 28.00 28.28 28.73 29.18 29.64 30.00 30.00 35.00 38.00
##   20%   25%   30%   40%   50%   60%   70%   75%   80%   90%   95%   96%
## 43.00 44.00 47.00 50.00 53.00 56.00 64.00 69.00 75.00 86.00 93.00 93.00
##   97%   98%   99%   99% 99.1% 99.2% 99.3% 99.4% 99.5% 99.6% 99.7% 99.8%
## 93.00 93.00 93.45 93.45 93.90 94.00 94.00 94.00 94.00 94.00 94.00 94.54
## 99.9%
## 97.27
```

4. Wind Speed

```
hist(bikejan$windspeed,xlab="wind speed")
```




```
boxplot(bikejan$windspeed,xlab="wind speed")
```



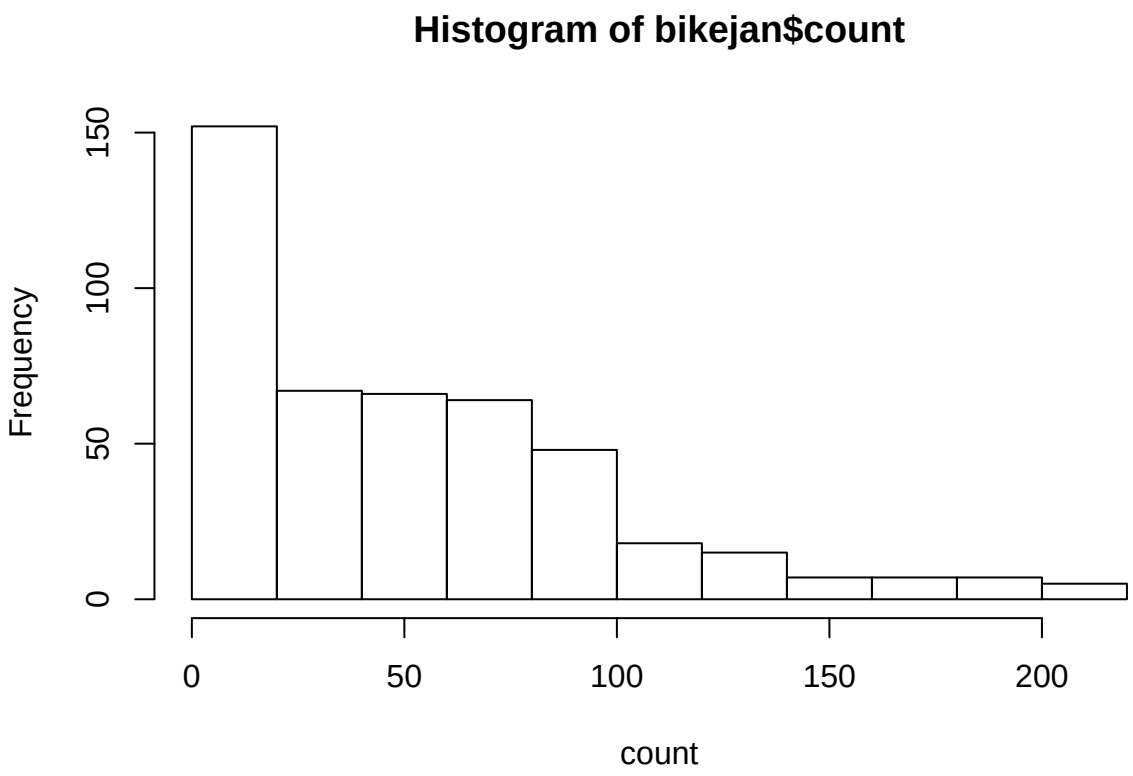
wind speed

```
quantile(bikejan$windspeed,c(x/1000,0.05,0.1,0.2,0.25,0.3,0.4,0.5,0.6,0.7,0.75,0.8,0.9,0.95,0.96,0.97,0
```

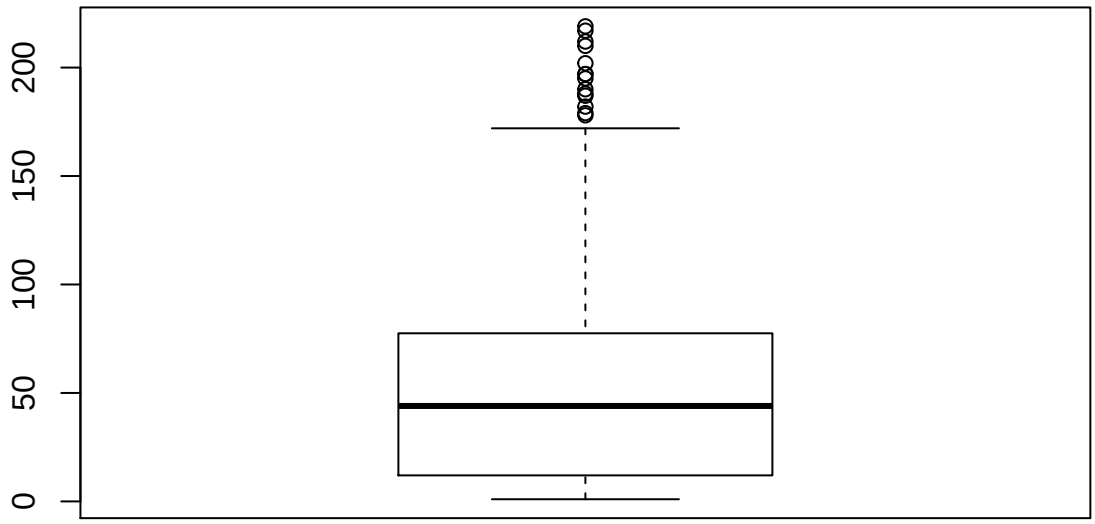
```
##   0.1%   0.2%   0.3%   0.4%   0.5%   0.6%   0.7%   0.8%   0.9%     1%
##  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
##     5%    10%    20%    25%    30%    40%    50%    60%    70%    75%
##  0.000  4.502  7.002  8.998  8.998 11.001 12.998 15.001 19.001 19.001
##    80%    90%    95%    96%    97%    98%    99%    99%  99.1%  99.2%
## 20.000 23.999 27.999 30.003 30.003 30.901 33.899 33.899 34.810 35.001
##  99.3%  99.4%  99.5%  99.6%  99.7%  99.8%  99.9%
## 35.001 35.001 35.001 35.360 36.269 37.178 38.089
```

5. Count

```
hist(bikejan$count,xlab="count")
```




```
boxplot(bikejan$count,xlab="count")
```



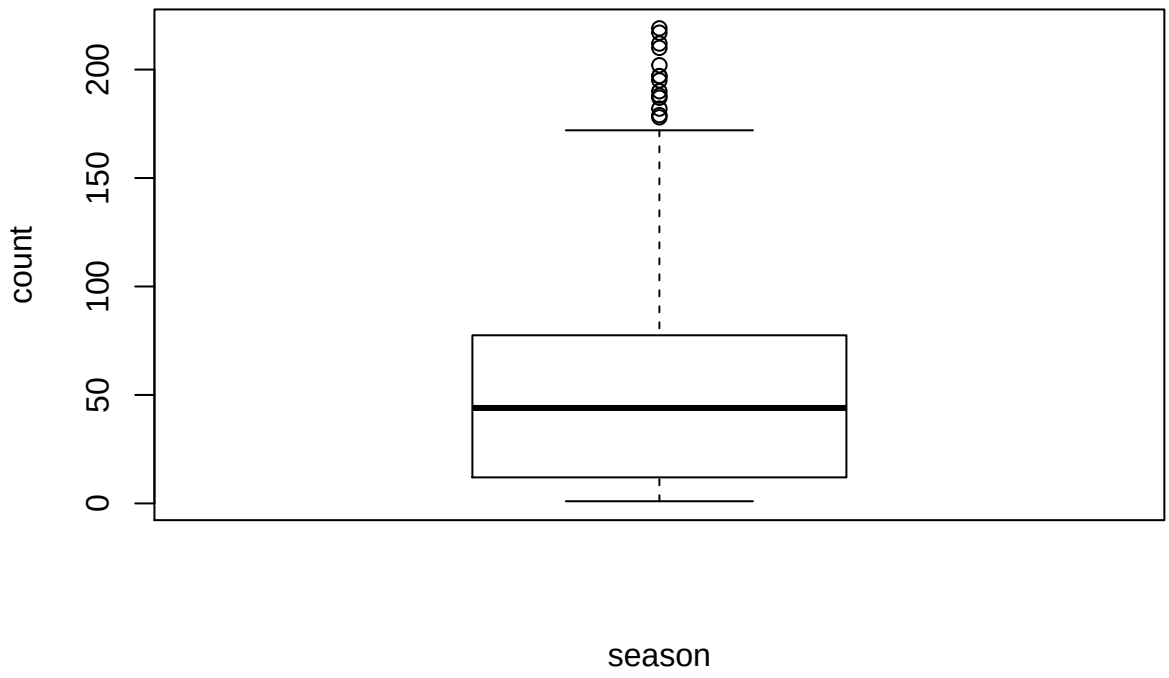
count

```
quantile(bikejan$count,c(x/1000,0.05,0.1,0.2,0.25,0.3,0.4,0.5,0.6,0.7,0.75,0.8,0.9,0.95,0.96,0.97,0.98,
```

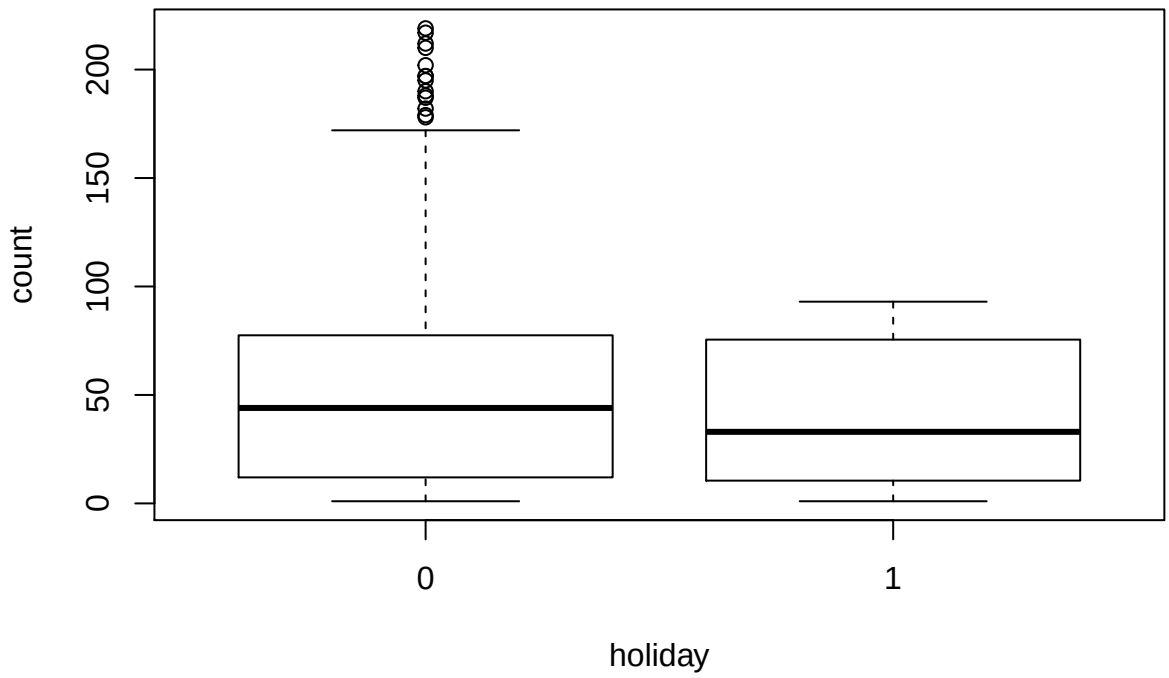
```
##   0.1%   0.2%   0.3%   0.4%   0.5%   0.6%   0.7%   0.8%   0.9%     1%
##   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
##     5%    10%    20%    25%    30%    40%    50%    60%    70%    75%
##   1.00   3.00   6.00  12.00  17.00  32.00  44.00  57.00  71.00  77.25
##    80%    90%    95%    96%    97%    98%    99%    99%  99.1%  99.2%
##  86.00 114.00 155.50 160.60 174.10 187.90 199.25 199.25 201.52 204.88
##  99.3%  99.4%  99.5%  99.6%  99.7%  99.8%  99.9%
## 208.52 210.54 211.45 212.90 215.17 217.18 218.09
```

Bivariate Analysis with categorical variables

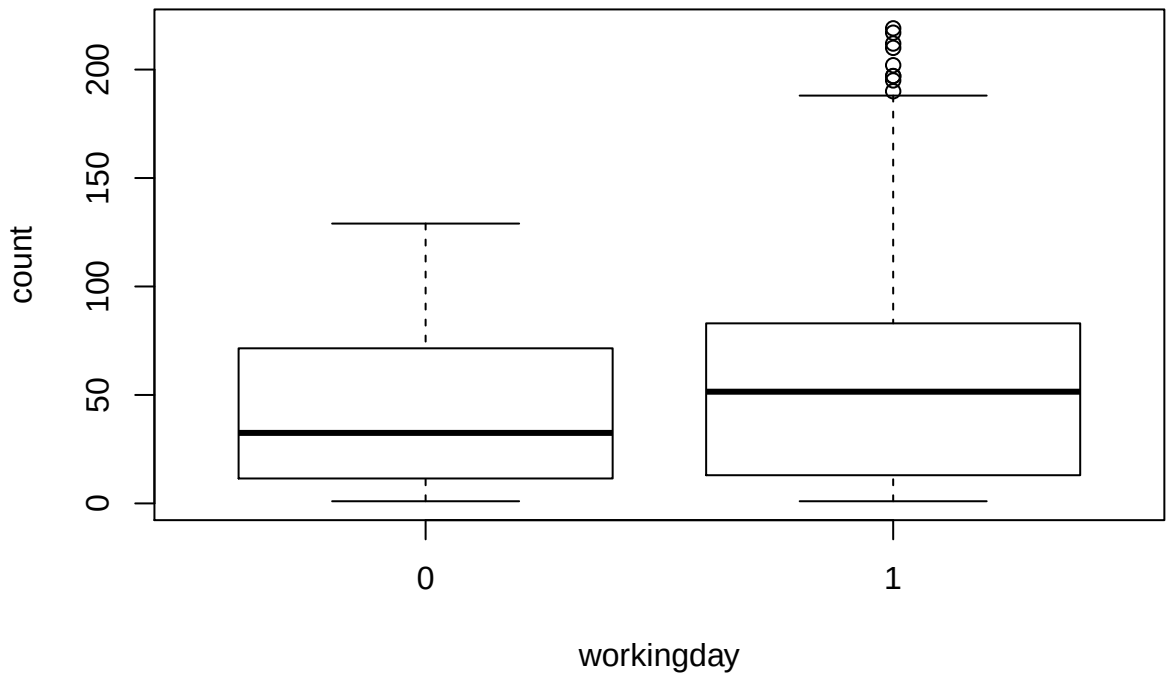
```
boxplot(count~season,bikejan,xlab="season",ylab="count")
```



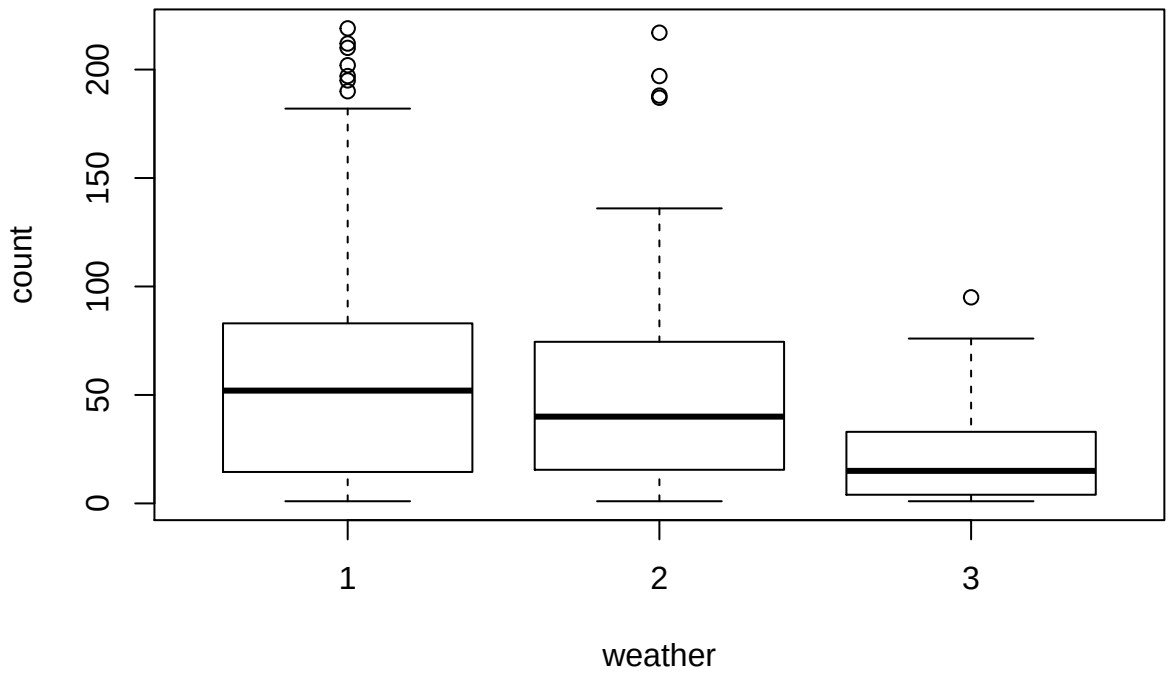

```
boxplot(count~holiday,bikejan,xlab="holiday",ylab="count")
```




```
boxplot(count~workingday,bikejan,xlab="workingday",ylab="count")
```

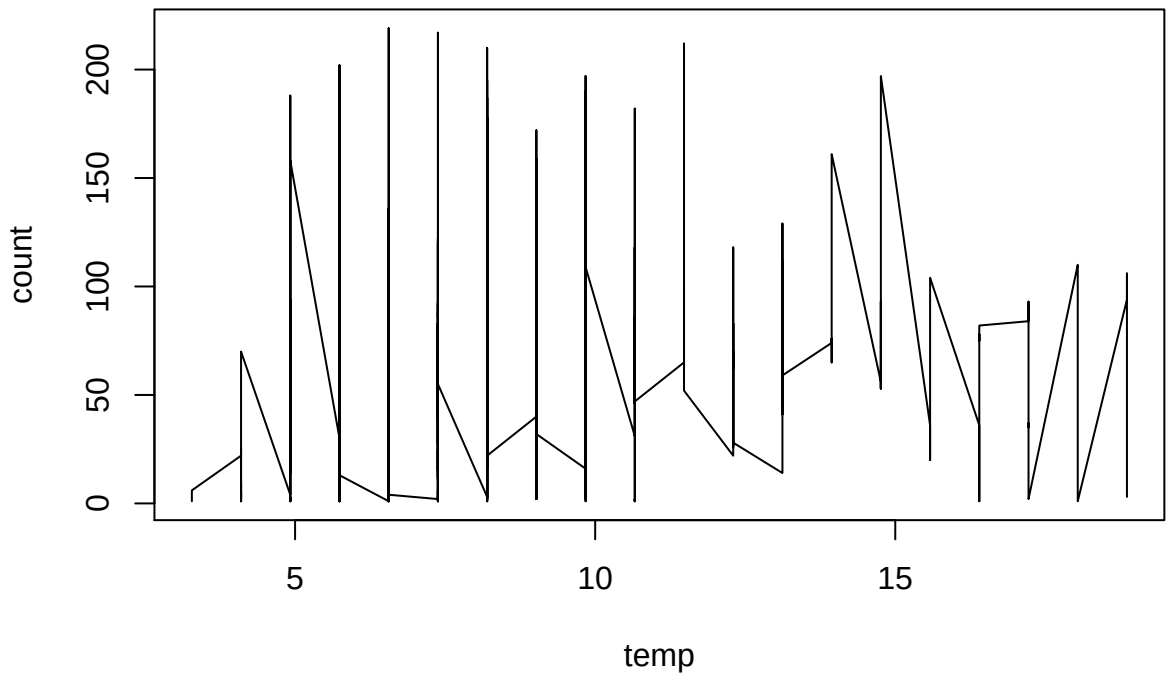



```
boxplot(count~weather,bikejan,xlab="weather",ylab="count")
```

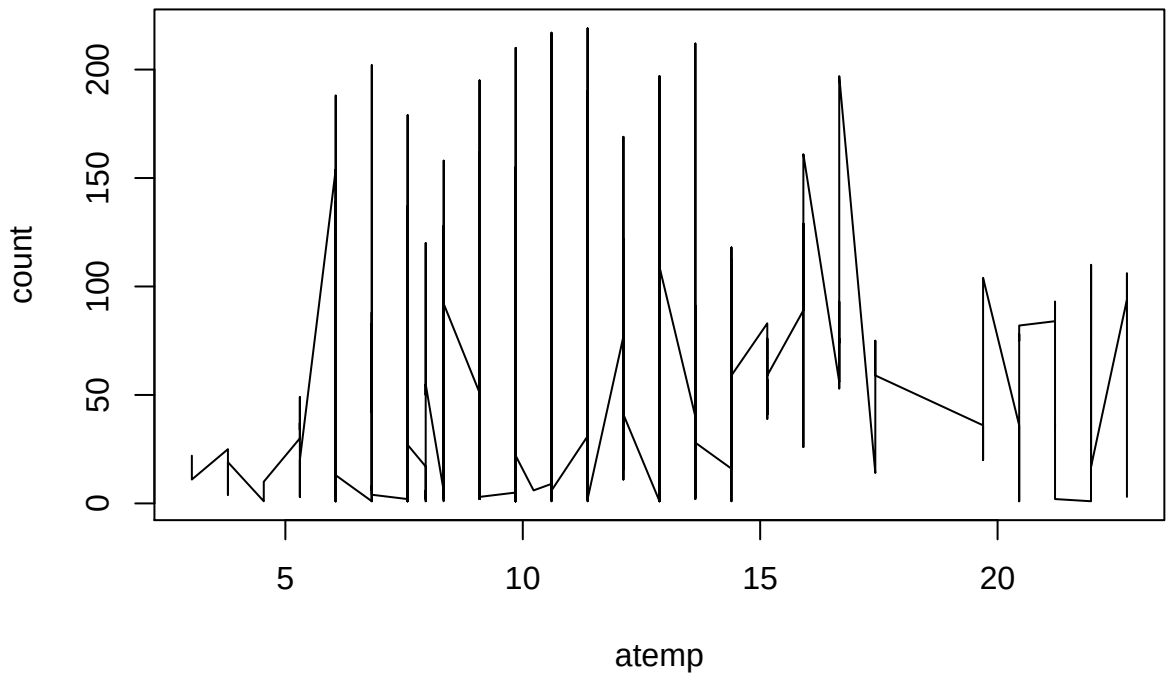


Bivariate Analysis with continuous variables

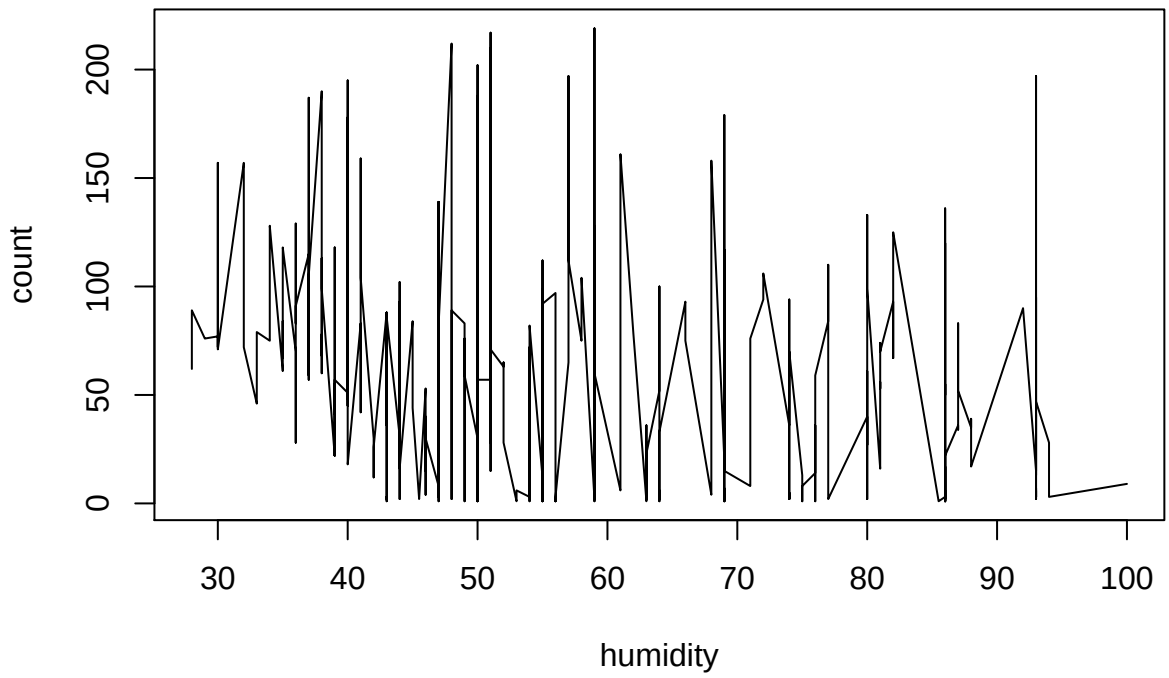
```
plot(count~temp,bikejan[order(bikejan$temp),],type="l",xlab="temp",ylab="count")
```



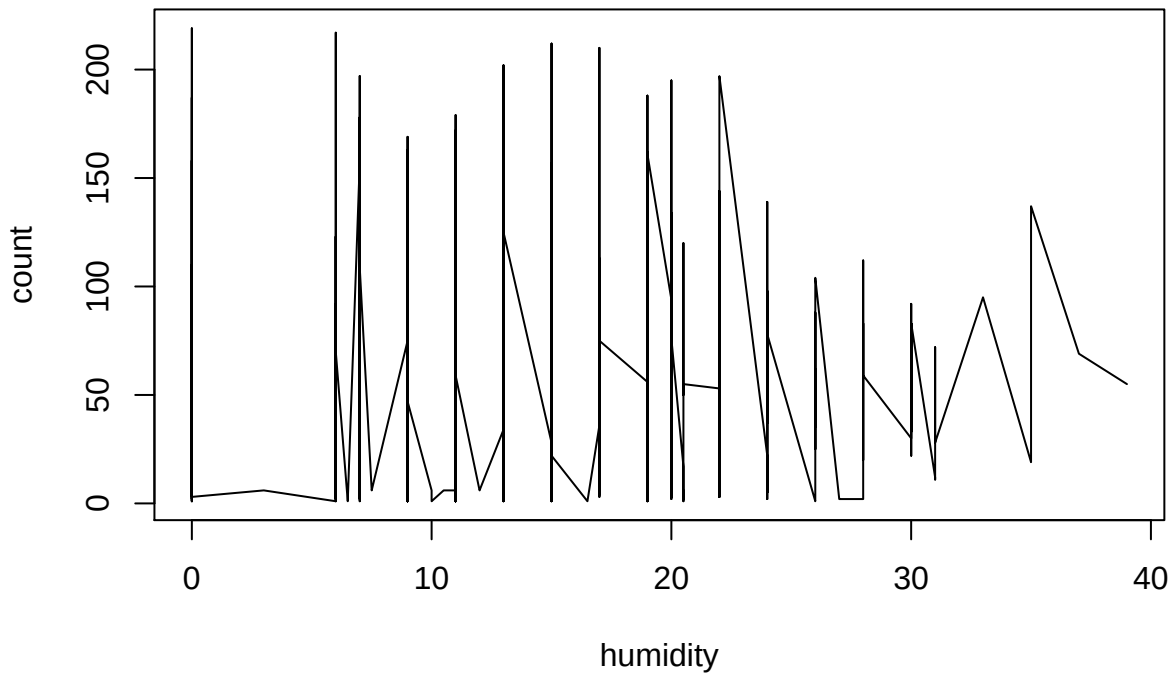

```
plot(count~atemp,bikejan[order(bikejan$atemp),],type="l",xlab="atemp",ylab="count")
```




```
plot(count~humidity,bikejan[order(bikejan$humidity),],type="l",xlab="humidity",ylab="count")
```




```
plot(count~windspeed,bikejan[order(bikejan$windspeed),],type="l",xlab="humidity",ylab="count")
```



Time series Analysis

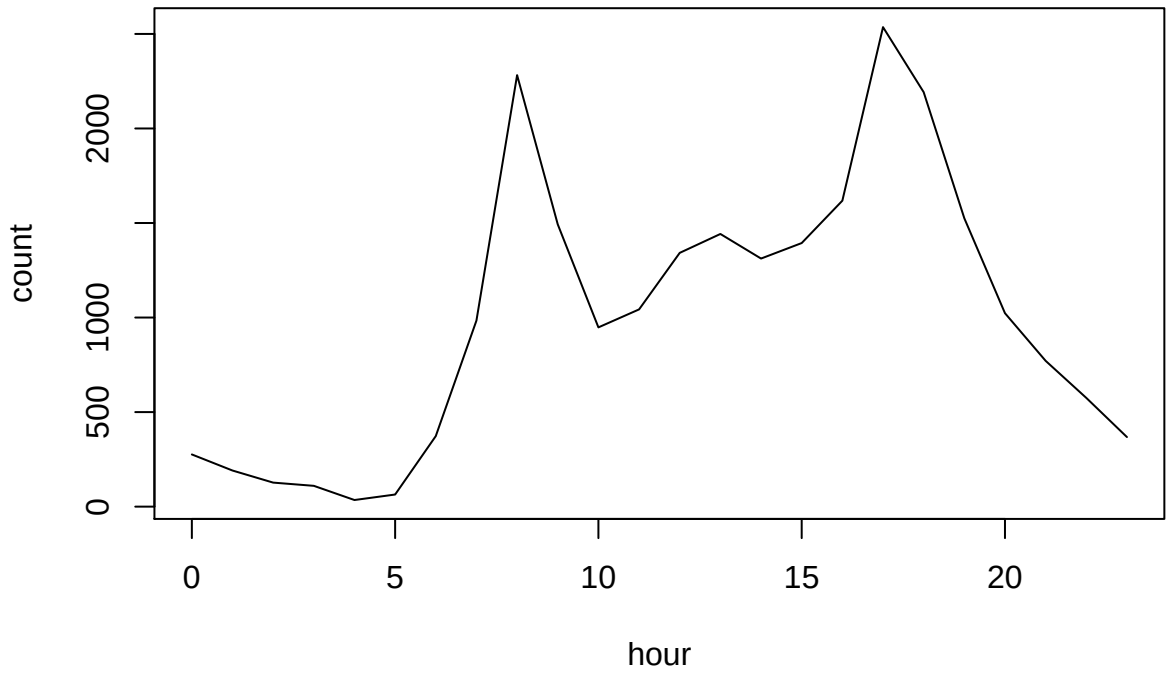
---

1. Hour

```
bikejan_hour <- aggregate(count~hour,bikejan,sum)
head(bikejan_hour[order(-bikejan_hour$count),],4)
```

```
##    hour count
## 18   17  2536
## 9     8  2282
## 19   18  2192
## 17   16  1618
```

```
plot(count~hour,bikejan_hour,type="l")
```

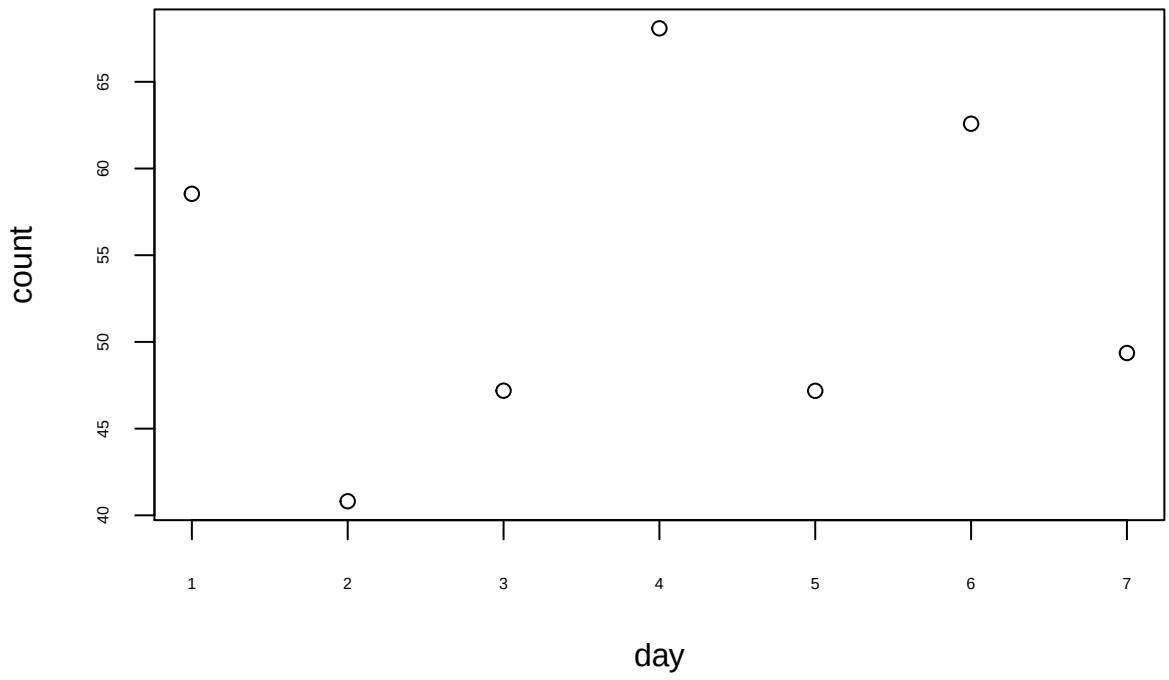


2. Day

```
bikejan_day <- aggregate(count~day,bikejan,mean)
bikejan_day[order(-bikejan_day$count),]
```

```
##   day count
## 4   4 68.08
## 6   6 62.58
## 1   1 58.54
## 7   7 49.36
## 3   3 47.19
## 5   5 47.18
## 2   2 40.81
```

```
plot(count~day,bikejan_day,cex.axis=0.50)
```



3. Date

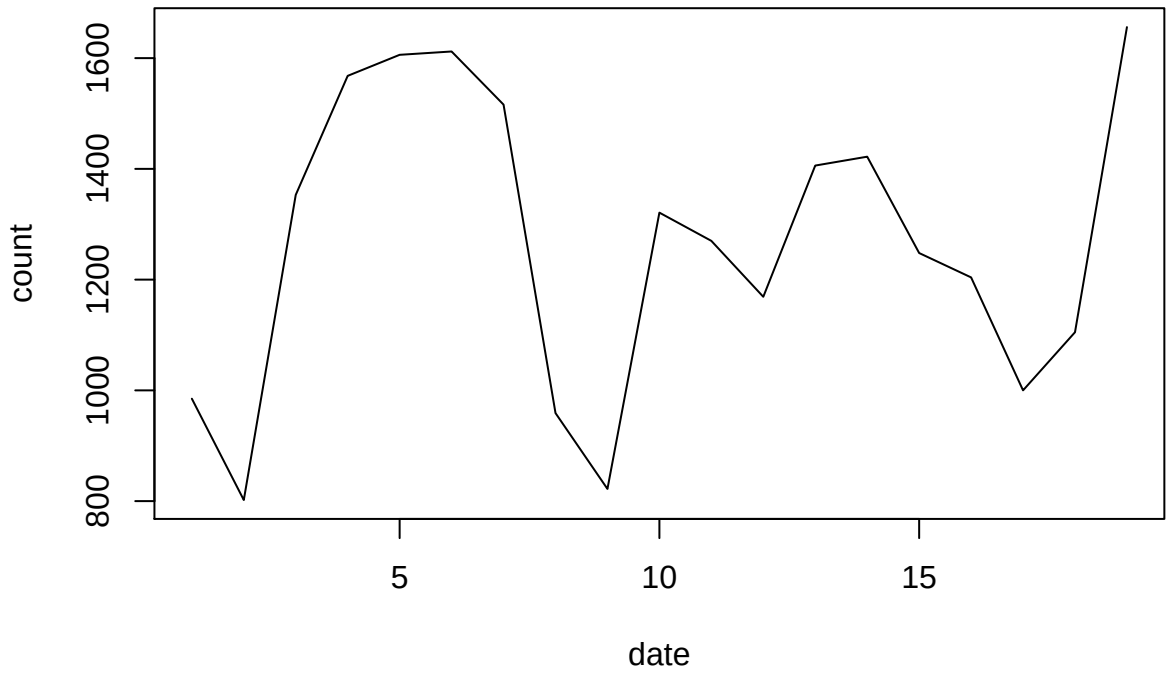
```
bikejan_date <- aggregate(count~date,bikejan,sum)
head(bikejan_date[order(-bikejan_date$count),])
```

```
##    date count
## 19   19  1656
## 6     6  1612
## 5     5  1606
## 4     4  1568
## 7     7  1516
## 14   14  1422
```

```
tail(bikejan_date[order(-bikejan_date$count),])
```

```
##    date count
## 18   18  1105
## 17   17  1000
## 1     1   985
## 8     8   959
## 9     9   822
## 2     2   802
```

```
plot(count~date,bikejan_date,type="l")
```



Correlation

```
cor(bikejan[,-c(1,18,17,6,15,14,13,11,10)])
```

```
## Warning: the standard deviation is zero
```

```
##            season  holiday workingday  weather   atemp humidity windspeed
## season          1       NA         NA       NA      NA       NA        NA
## holiday        NA  1.00000   -0.30861  0.26193 -0.1108 -0.04875  -0.02607
## workingday     NA -0.30861    1.00000 -0.14604 -0.2322  0.01107  -0.11545
## weather        NA  0.26193   -0.14604  1.00000  0.2118  0.53104  -0.14539
## atemp          NA -0.11085   -0.23221  0.21185  1.0000  0.27018  -0.21568
## humidity       NA -0.04875    0.01107  0.53104  0.2702  1.00000  -0.32051
## windspeed      NA -0.02607   -0.11545 -0.14539 -0.2157 -0.32051   1.00000
## count          NA -0.05473    0.17542 -0.17627  0.1408 -0.26894   0.08240
## hour           NA  0.00000    0.00000 -0.05503  0.1437 -0.20945   0.14173
##               count     hour
## season           NA       NA
## holiday    -0.05473  0.00000
## workingday  0.17542  0.00000
```

```
## weather    -0.17627 -0.05503
## atemp       0.14076  0.14369
## humidity   -0.26894 -0.20945
## windspeed   0.08240  0.14173
## count       1.00000  0.37426
## hour        0.37426  1.00000
```

Summary of EDA

1. Spring season whole of january
2. 17th of January was a holiday and a Monday
3. 3 saturdays, 3 sundays and 1 Monday were holidays
4. No extreme weathers, even light rains are found only in 33 observations
5. feel of temeprature is greater than actual temp.
6. only one season throughout january
7. people rent more bikes when their are no holidays but there was only 1 day of holiday so this may not be correct metric to show
8. people rent more bikes on working days than on holidays/saturday/sundays#clearly, weather has a role to play for people to rent bike. '3' depics rainy weather hence less bikes, '1' depicts clear weather hence more bikes, '2' is misty.#more bikes are rented when temp between 5-10, humidity between 40-60 and windspeed between 8-22# more bikes are in hours 8 AM and 5,6 PM # clearly there is a dip in the values on holidays

Model

```
#converting all categorical variables as factor variables
bikejan$season <- as.factor(bikejan$season)
bikejan$holiday <- as.factor(bikejan$holiday)
bikejan$workingday <- as.factor(bikejan$workingday)
bikejan$hour <- as.numeric(bikejan$hour)
bikejan$day <- as.numeric(bikejan$day)
#weather is taken as numeric variable, as there is a value in the prediction data set with weather=4, t
bikejan$weather <- as.numeric(bikejan$weather)
```

```
#partitioning the data into train dataset and test dataset
library(caret)
```

```
## Warning: package 'caret' was built under R version 3.1.1
```

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

```
## Warning: package 'ggplot2' was built under R version 3.1.1
```

```
intrain <- createDataPartition(bikejan$count,times=1,p=.8, list=FALSE)
trainjan <- bikejan[intrain,]
testjan <- bikejan[-intrain,]
```

```r
#let us put all the variables in the model
library(car)
```

```
## Warning: package 'car' was built under R version 3.1.1
```

```r
library(MASS)
model <- lm(count~ holiday+workingday+weather+temp+atemp+humidity+windspeed+hour+day, trainjan)
vif(model)
```

```
##    holiday workingday    weather       temp      atemp   humidity
##      1.396      1.329      1.673     63.273     64.570      1.720
##  windspeed       hour        day
##      6.844      1.132      1.140
```

```r
#VIF of temp and atemp is very high, they are collinear variables, so we drop atemp, as it has high val
model <- lm(count~ holiday+workingday+weather+temp+humidity+windspeed+hour+day, trainjan)
vif(model)
```

```
##    holiday workingday    weather       temp   humidity  windspeed
##      1.389      1.322      1.649      1.351      1.695      1.151
##       hour        day
##      1.127      1.105
```

```r
#The VIF of all variable is less than 2, hence we consider al the variables for the model, let us ty to
model_bike <- stepAIC(model,direction= "both")
```

```
## Start:  AIC=2757
## count ~ holiday + workingday + weather + temp + humidity + windspeed +
##     hour + day
##
##              Df Sum of Sq    RSS  AIC
## - windspeed   1      1114 640743 2756
## - day         1      1316 640945 2756
## - weather     1      2029 641658 2756
## - holiday     1      2165 641794 2756
## <none>                    639629 2757
## - humidity    1     23431 663060 2768
## - workingday  1     38039 677668 2776
## - temp        1     42863 682492 2779
## - hour        1     54700 694329 2785
##
## Step:  AIC=2756
## count ~ holiday + workingday + weather + temp + humidity + hour +
##     day
##
##              Df Sum of Sq    RSS  AIC
## - day         1      1322 642065 2754
## - weather     1      2081 642824 2755
## - holiday     1      2327 643070 2755
## <none>                    640743 2756
## + windspeed   1      1114 639629 2757
```

```
## - humidity    1     22400 663143 2766
## - workingday  1     38687 679430 2775
## - temp        1     41802 682545 2777
## - hour        1     53955 694698 2783
##
## Step:  AIC=2754
## count ~ holiday + workingday + weather + temp + humidity + hour
##
##              Df Sum of Sq    RSS  AIC
## - holiday     1      1752 643818 2753
## - weather     1      2441 644506 2754
## <none>                    642065 2754
## + day         1      1322 640743 2756
## + windspeed   1      1121 640945 2756
## - humidity    1     21764 663829 2765
## - workingday  1     39801 681866 2774
## - temp        1     41675 683740 2775
## - hour        1     54384 696449 2782
##
## Step:  AIC=2753
## count ~ workingday + weather + temp + humidity + hour
##
##              Df Sum of Sq    RSS  AIC
## - weather     1      1421 645239 2752
## <none>                    643818 2753
## + holiday     1      1752 642065 2754
## + windspeed   1      1261 642556 2755
## + day         1       748 643070 2755
## - humidity    1     24913 668730 2765
## - workingday  1     38901 682718 2773
## - temp        1     40030 683848 2774
## - hour        1     54919 698737 2781
##
## Step:  AIC=2752
## count ~ workingday + temp + humidity + hour
##
##              Df Sum of Sq    RSS  AIC
## <none>                    645239 2752
## + weather     1      1421 643818 2753
## + windspeed   1      1264 643974 2754
## + day         1      1110 644129 2754
## + holiday     1       733 644506 2754
## - temp        1     39454 684692 2772
## - workingday  1     42847 688085 2774
## - humidity    1     43624 688863 2774
## - hour        1     53869 699108 2780
```

```
model_bike$anova
```

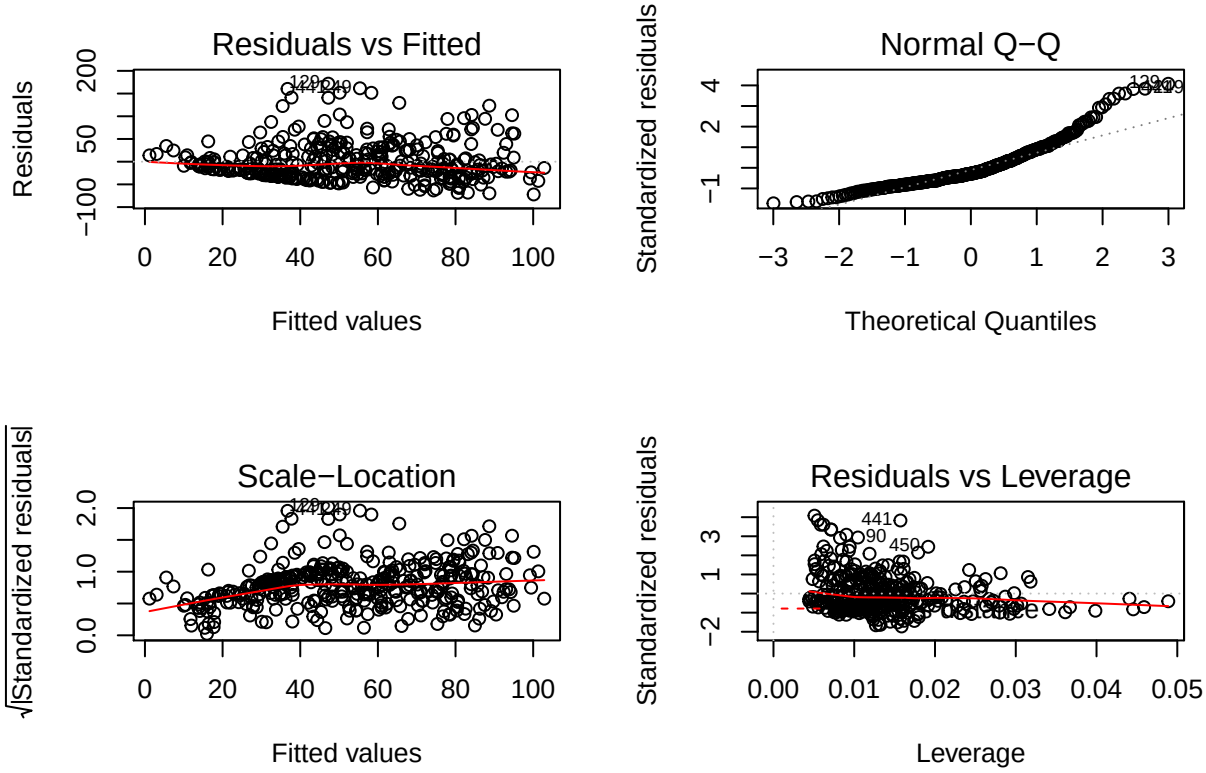
```
## Stepwise Model Path
## Analysis of Deviance Table
##
## Initial Model:
## count ~ holiday + workingday + weather + temp + humidity + windspeed +
```

```
##     hour + day
##
## Final Model:
## count ~ workingday + temp + humidity + hour
##
##
##          Step Df Deviance Resid. Df Resid. Dev  AIC
## 1                                358     639629 2757
## 2 - windspeed  1     1114       359     640743 2756
## 3       - day  1     1322       360     642065 2754
## 4   - holiday  1     1752       361     643818 2753
## 5   - weather  1     1421       362     645239 2752
```

```
#using stepwise regression it has dropped the 'holiday' variable. When cheked with the initial model, h
summary(model_bike)
```

```
##
## Call:
## lm(formula = count ~ workingday + temp + humidity + hour, data = trainjan)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -72.1  -28.2  -11.7   19.4  171.8
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   23.673     10.604    2.23    0.026 *
## workingday1   23.831      4.861    4.90  1.4e-06 ***
## temp           3.579      0.761    4.70  3.6e-06 ***
## humidity      -0.654      0.132   -4.95  1.2e-06 ***
## hour           1.853      0.337    5.50  7.3e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 42.2 on 362 degrees of freedom
## Multiple R-squared:  0.232,  Adjusted R-squared:  0.223
## F-statistic: 27.3 on 4 and 362 DF,  p-value: <2e-16
```

```
par(mfrow=c(2,2))
plot(model_bike)
```




```
testjan$season <- as.factor(testjan$season)
testjan$holiday <- as.factor(testjan$holiday)
testjan$workingday <- as.factor(testjan$workingday)
testjan$hour <- as.numeric(testjan$hour)
testjan$weather <- as.numeric(testjan$weather)
testjan$day <- as.numeric(testjan$day)
#predicting count values from the model
predict_test_lm <- ceiling(predict(model,testjan))
```

```
#classification tree model
modfit_tree <- train(count ~ holiday+workingday+weather+temp+atemp+humidity+windspeed+hour+day, data= t
```

```
## Loading required package: rpart
```

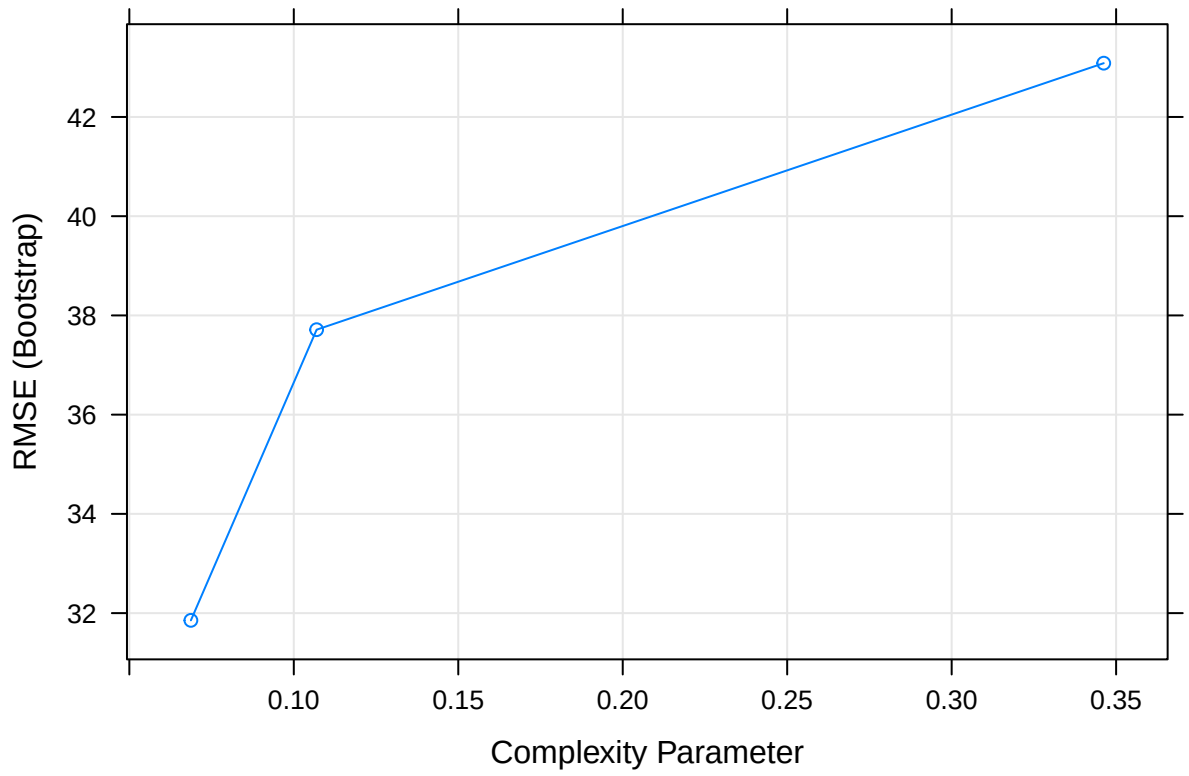
```
## Warning: There were missing values in resampled performance measures.
```

```
modfit_tree$finalModel
```

```
## n= 367
##
## node), split, n, deviance, yval
##       * denotes terminal node
##
##  1) root 367 840000  52.930
```

```
##    2) hour< 6.5 106  11330   8.755 *
##    3) hour>=6.5 261 537900  70.870
##      6) hour>=20.5 46   9546  30.760 *
##      7) hour< 20.5 215 438500  79.450
##       14) workingday1< 0.5 82  83880  60.950 *
##       15) workingday1>=0.5 133 309200  90.860
##         30) hour>=9.5 100 176300  79.850
##           60) hour< 16.5 66  22590  59.680 *
##           61) hour>=16.5 34  74770 119.000 *
##         31) hour< 9.5 33  84090 124.200 *
```

```
plot(modfit_tree)
```




```
predict_test_tree <- ceiling(predict(modfit_tree,testjan))
```

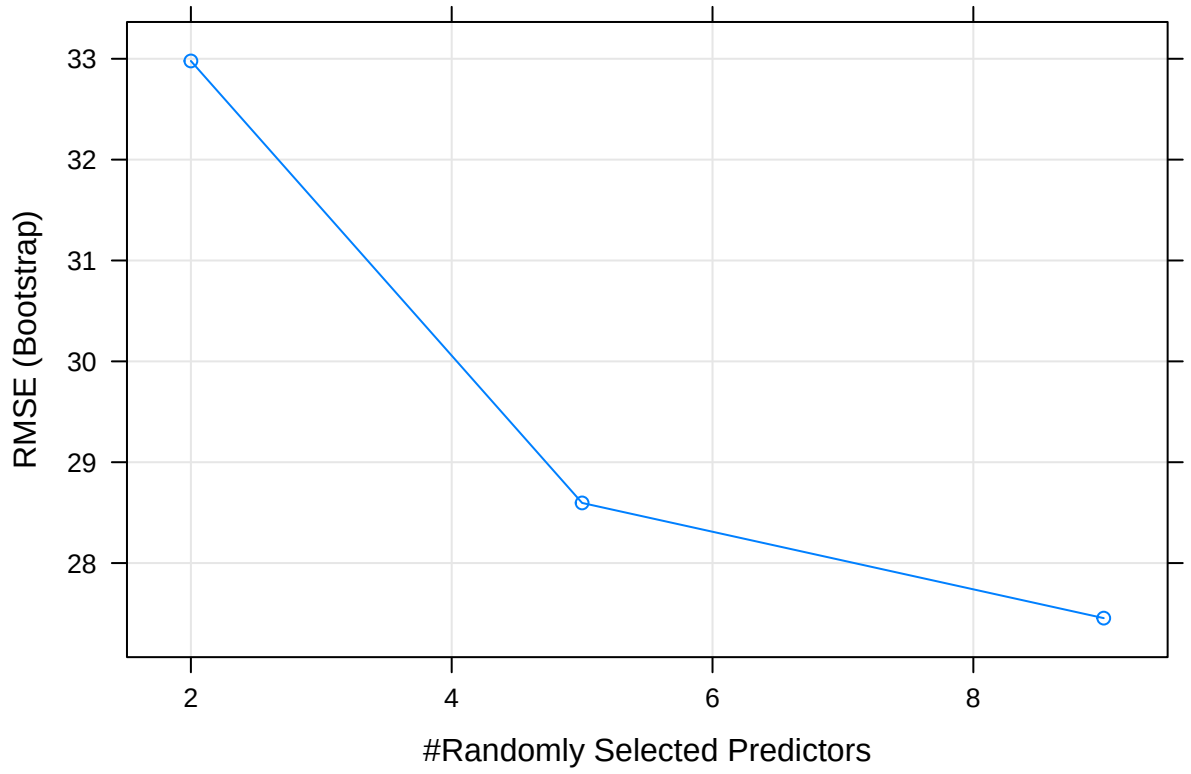
```
#random forest model
modfit_rf <- train(count ~ holiday+workingday+weather+temp+atemp+humidity+windspeed+hour+day, data= tes
```

```
## Loading required package: randomForest
```

```
## Warning: package 'randomForest' was built under R version 3.1.1
```

```
## randomForest 4.6-10
## Type rfNews() to see new features/changes/bug fixes.
```

```
plot(modfit_rf)
```




```
modfit_rf
```

```
## Random Forest
##
## 89 samples
## 17 predictors
##
## No pre-processing
## Resampling: Bootstrapped (25 reps)
##
## Summary of sample sizes: 89, 89, 89, 89, 89, 89, ...
##
## Resampling results across tuning parameters:
##
##   mtry  RMSE  Rsquared  RMSE SD  Rsquared SD
##   2     33    0.5       5        0.1
##   5     29    0.6       5        0.1
##   9     27    0.7       4        0.1
##
## RMSE was used to select the optimal model using  the smallest value.
## The final value used for the model was mtry = 9.
```

```
predict_test_rf <- ceiling(predict(modfit_rf,testjan))
```

```
mape <- function(y,yhat)
  {sum(abs((y-yhat)/yhat))}
mape (testjan$count,predict_test_lm)
```

```
## [1] 52.88
```

```
mape (testjan$count,predict_test_tree)
```

```
## [1] 40.33
```

```
mape (testjan$count,predict_test_rf)
```

```
## [1] 21.24
```