Mva_Project1.R

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```
###### Assignment 3 ###############

## EDA
## Data Cleaning
## Tests

#Getting working directory
getwd()
```

```
## [1] "/Users/mihikagupta/Desktop"
```

```
#Setting directory to load dataset
setwd("/Users/mihikagupta/Desktop")

#Reading the data into a dataframe
df <- read.csv(file = 'US_Acc_June20.csv')

# Printing first few columns of dataset for inference
head(df)
```

```
##    ID   Source TMC Severity          Start_Time            End_Time Start_Lat
## 1 A-1 MapQuest 201        3 2016-02-08 05:46:00 2016-02-08 11:00:00  39.86515
## 2 A-2 MapQuest 201        2 2016-02-08 06:07:59 2016-02-08 06:37:59  39.92806
## 3 A-3 MapQuest 201        2 2016-02-08 06:49:27 2016-02-08 07:19:27  39.06315
## 4 A-4 MapQuest 201        3 2016-02-08 07:23:34 2016-02-08 07:53:34  39.74775
## 5 A-5 MapQuest 201        2 2016-02-08 07:39:07 2016-02-08 08:09:07  39.62778
## 6 A-6 MapQuest 201        3 2016-02-08 07:44:26 2016-02-08 08:14:26  40.10059
##   Start_Lng End_Lat End_Lng Distance.mi.
## 1 -84.05872      NA      NA         0.01
## 2 -82.83118      NA      NA         0.01
## 3 -84.03261      NA      NA         0.01
## 4 -84.20558      NA      NA         0.01
## 5 -84.18835      NA      NA         0.01
## 6 -82.92519      NA      NA         0.01
##                                                                                Description
## 1 Right lane blocked due to accident on I-70 Eastbound at Exit 41 OH-235 State Route 4.
## 2                                  Accident on Brice Rd at Tussing Rd. Expect delays.
## 3           Accident on OH-32 State Route 32 Westbound at Dela Palma Rd. Expect delays.
## 4                     Accident on I-75 Southbound at Exits 52 52B US-35. Expect delays.
## 5             Accident on McEwen Rd at OH-725 Miamisburg Centerville Rd. Expect delays.
## 6     Accident on I-270 Outerbelt Northbound near Exit 29 OH-3 State St. Expect delays.
##   Number                    Street Side         City     County State
## 1     NA                    I-70 E    R       Dayton Montgomery    OH
## 2   2584                 Brice Rd    L Reynoldsburg   Franklin    OH
```

```
## 3     NA            State Route 32    R Williamsburg   Clermont    OH
## 4     NA                     I-75 S    R       Dayton Montgomery    OH
## 5     NA Miamisburg Centerville Rd    R       Dayton Montgomery    OH
## 6     NA            Westerville Rd    R  Westerville   Franklin    OH
##      Zipcode Country   Timezone Airport_Code   Weather_Timestamp Temperature.F.
## 1      45424      US US/Eastern         KFFO 2016-02-08 05:58:00           36.9
## 2 43068-3402      US US/Eastern         KCMH 2016-02-08 05:51:00           37.9
## 3      45176      US US/Eastern         KI69 2016-02-08 06:56:00           36.0
## 4      45417      US US/Eastern         KDAY 2016-02-08 07:38:00           35.1
## 5      45459      US US/Eastern         KMGY 2016-02-08 07:53:00           36.0
## 6      43081      US US/Eastern         KCMH 2016-02-08 07:51:00           37.9
##   Wind_Chill.F. Humidity... Pressure.in. Visibility.mi. Wind_Direction
## 1            NA          91        29.68             10           Calm
## 2            NA         100        29.65             10           Calm
## 3          33.3         100        29.67             10             SW
## 4          31.0          96        29.64              9             SW
## 5          33.3          89        29.65              6             SW
## 6          35.5          97        29.63              7            SSW
##   Wind_Speed.mph. Precipitation.in. Weather_Condition Amenity  Bump Crossing
## 1              NA              0.02        Light Rain   False False    False
## 2              NA              0.00        Light Rain   False False    False
## 3             3.5                NA          Overcast   False False    False
## 4             4.6                NA     Mostly Cloudy   False False    False
## 5             3.5                NA     Mostly Cloudy   False False    False
## 6             3.5              0.03        Light Rain   False False    False
##   Give_Way Junction No_Exit Railway Roundabout Station  Stop Traffic_Calming
## 1    False    False   False   False      False   False False           False
## 2    False    False   False   False      False   False False           False
## 3    False    False   False   False      False   False False           False
## 4    False    False   False   False      False   False False           False
## 5    False    False   False   False      False   False False           False
## 6    False    False   False   False      False   False False           False
##   Traffic_Signal Turning_Loop Sunrise_Sunset Civil_Twilight Nautical_Twilight
## 1          False        False          Night          Night             Night
## 2          False        False          Night          Night             Night
## 3           True        False          Night          Night               Day
## 4          False        False          Night            Day               Day
## 5           True        False            Day            Day               Day
## 6          False        False            Day            Day               Day
##   Astronomical_Twilight
## 1                 Night
## 2                   Day
## 3                   Day
## 4                   Day
## 5                   Day
## 6                   Day
```

```
## DATA EXPLORATION AND REDUCTION ##

## Setting random seed to shuflle data before splitting
set.seed(23)

#Checking number of rows
rows<-sample(nrow(df))
```

```r
#Shuffling the data
mva<-df[rows,]

#Taking the required number of instances from the shuffled data to reduce any biases
mva<-mva[500000:1000000,]

#Checking the structure of the dataset
str(mva)
```

```
## 'data.frame':    500001 obs. of  49 variables:
##  $ ID                    : chr  "A-210675" "A-1806002" "A-1932273" "A-11427" ...
##  $ Source                : chr  "MapQuest" "MapQuest" "MapQuest" "MapQuest" ...
##  $ TMC                   : num  241 201 201 201 NA 201 245 201 NA 201 ...
##  $ Severity              : int  3 2 2 2 2 2 3 2 2 3 ...
##  $ Start_Time            : chr  "2016-10-05 18:56:21" "2018-06-04 07:56:44" "2018-04-04 16:38:49" "201
##  $ End_Time              : chr  "2016-10-05 19:41:07" "2018-06-04 08:26:29" "2018-04-04 17:23:33" "201
##  $ Start_Lat             : num  40.8 40.3 33.7 37.6 38.6 ...
##  $ Start_Lng             : num  -74.3 -75.7 -117.9 -122.1 -121.6 ...
##  $ End_Lat               : num  NA NA NA NA 38.6 ...
##  $ End_Lng               : num  NA NA NA NA -122 ...
##  $ Distance.mi.          : num  0 0 0 0.01 0 0.01 0 0 0 0 ...
##  $ Description           : chr  "Left lane blocked due to accident on I-280 Westbound at Exits 4A 4B (
##  $ Number                : num  NA 1535 NA NA NA ...
##  $ Street                : chr  "I-280 E" "Sell Rd" "Corona del Mar Fwy N" "W Jackson St" ...
##  $ Side                  : chr  "R" "L" "R" "R" ...
##  $ City                  : chr  "Roseland" "Pottstown" "Costa Mesa" "Hayward" ...
##  $ County                : chr  "Essex" "Montgomery" "Orange" "Alameda" ...
##  $ State                 : chr  "NJ" "PA" "CA" "CA" ...
##  $ Zipcode               : chr  "07068" "19464" "92626" "94544" ...
##  $ Country               : chr  "US" "US" "US" "US" ...
##  $ Timezone              : chr  "US/Eastern" "US/Eastern" "US/Pacific" "US/Pacific" ...
##  $ Airport_Code          : chr  "KCDW" "KPTW" "KSNA" "KHWD" ...
##  $ Weather_Timestamp     : chr  "2016-10-05 18:53:00" "2018-06-04 07:54:00" "2018-04-04 16:53:00" "201
##  $ Temperature.F.        : num  60.1 54 62.1 54 65 ...
##  $ Wind_Chill.F.         : num  NA NA NA NA 65 NA NA NA 55 NA ...
##  $ Humidity...           : num  67 93 72 59 15 87 96 54 38 12 ...
##  $ Pressure.in.          : num  30.3 29.8 30 30.1 29.9 ...
##  $ Visibility.mi.        : num  10 8 9 7 10 10 0.8 10 10 10 ...
##  $ Wind_Direction        : chr  "Calm" "NE" "SW" "NE" ...
##  $ Wind_Speed.mph.       : num  NA 4.6 8.1 9.2 17 9.2 NA NA 10 NA ...
##  $ Precipitation.in.     : num  NA NA NA NA 0 0 0.11 0 0 NA ...
##  $ Weather_Condition     : chr  "Clear" "Scattered Clouds" "Partly Cloudy" "Partly Cloudy" ...
##  $ Amenity               : chr  "False" "False" "False" "False" ...
##  $ Bump                  : chr  "False" "False" "False" "False" ...
##  $ Crossing              : chr  "False" "False" "False" "False" ...
##  $ Give_Way              : chr  "False" "False" "False" "False" ...
##  $ Junction              : chr  "False" "False" "False" "False" ...
##  $ No_Exit               : chr  "False" "False" "False" "False" ...
##  $ Railway               : chr  "False" "False" "False" "False" ...
##  $ Roundabout            : chr  "False" "False" "False" "False" ...
##  $ Station               : chr  "False" "False" "False" "False" ...
##  $ Stop                  : chr  "False" "False" "False" "False" ...
##  $ Traffic_Calming       : chr  "False" "False" "False" "False" ...
```

```
##  $ Traffic_Signal       : chr  "False" "False" "False" "False" ...
##  $ Turning_Loop         : chr  "False" "False" "False" "False" ...
##  $ Sunrise_Sunset       : chr  "Night" "Day" "Day" "Day" ...
##  $ Civil_Twilight       : chr  "Day" "Day" "Day" "Day" ...
##  $ Nautical_Twilight    : chr  "Day" "Day" "Day" "Day" ...
##  $ Astronomical_Twilight: chr  "Day" "Day" "Day" "Day" ...
```

```
# Checking the number of rows and columns in the current uncleaned dataset
ncol(mva)
```

```
## [1] 49
```

```
nrow(mva)
```

```
## [1] 500001
```

```
# Printing all the column names to find and filter the relevant and irrelevant attributes
names<-names(mva)
names
```

```
##  [1] "ID"                    "Source"                "TMC"
##  [4] "Severity"              "Start_Time"            "End_Time"
##  [7] "Start_Lat"             "Start_Lng"             "End_Lat"
## [10] "End_Lng"               "Distance.mi."          "Description"
## [13] "Number"                "Street"                "Side"
## [16] "City"                  "County"                "State"
## [19] "Zipcode"               "Country"               "Timezone"
## [22] "Airport_Code"          "Weather_Timestamp"     "Temperature.F."
## [25] "Wind_Chill.F."         "Humidity..."           "Pressure.in."
## [28] "Visibility.mi."        "Wind_Direction"        "Wind_Speed.mph."
## [31] "Precipitation.in."     "Weather_Condition"     "Amenity"
## [34] "Bump"                  "Crossing"              "Give_Way"
## [37] "Junction"              "No_Exit"               "Railway"
## [40] "Roundabout"            "Station"               "Stop"
## [43] "Traffic_Calming"       "Traffic_Signal"        "Turning_Loop"
## [46] "Sunrise_Sunset"        "Civil_Twilight"        "Nautical_Twilight"
## [49] "Astronomical_Twilight"
```

```
## DATA CLEANING ##

#Dropping the surplus attributes which do not contribute to the analysis
mva <- mva[-c(1:3,7:10,13,14,19,21:23,33,47:49)]

#Checking for any null values in the present dataset
# is.na(mva[,])

#Checking which rows have all the values filled and complete
# complete.cases(mva)

#Making a new dataframe with only the rows that have complete information and all values filled
Mva<-na.omit(mva)

#Verifying for missing values in the new dataframe
#complete.cases(Mva)

#Checking the number of rows and columns in the new CLEANED dataframe
ncol(Mva)
```

```
## [1] 32
```

```
nrow(Mva)
```

```
## [1] 182849
```

```
## EXPLORATORY DESCRIPTIVE STATISTICS ##

#Getting some basic initial statistical values for insights into the dataset
summary(Mva)
```

```
##     Severity     Start_Time          End_Time          Distance.mi.
##  Min.   :1.00   Length:182849      Length:182849      Min.   : 0.0000
##  1st Qu.:2.00   Class :character   Class :character   1st Qu.: 0.0000
##  Median :2.00   Mode  :character   Mode  :character   Median : 0.0000
##  Mean   :2.28                                         Mean   : 0.2903
##  3rd Qu.:3.00                                         3rd Qu.: 0.0000
##  Max.   :4.00                                         Max.   :79.4400
##  Description            Side               City              County
##  Length:182849      Length:182849      Length:182849      Length:182849
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##     State              Country          Temperature.F.   Wind_Chill.F.
##  Length:182849      Length:182849      Min.   :-24.00   Min.   :-50.10
##  Class :character   Class :character   1st Qu.: 48.00   1st Qu.: 46.00
##  Mode  :character   Mode  :character   Median : 63.00   Median : 63.00
##                                        Mean   : 61.03   Mean   : 59.57
##                                        3rd Qu.: 75.00   3rd Qu.: 75.00
##                                        Max.   :115.00   Max.   :115.00
##   Humidity...      Pressure.in.   Visibility.mi.    Wind_Direction
##  Min.   :  1.00   Min.   :20.19   Min.   :  0.000   Length:182849
##  1st Qu.: 49.00   1st Qu.:29.13   1st Qu.: 10.000   Class :character
##  Median : 69.00   Median :29.62   Median : 10.000   Mode  :character
##  Mean   : 65.53   Mean   :29.30   Mean   :  8.856
##  3rd Qu.: 85.00   3rd Qu.:29.92   3rd Qu.: 10.000
##  Max.   :100.00   Max.   :31.08   Max.   :100.000
##  Wind_Speed.mph.   Precipitation.in.   Weather_Condition      Bump
##  Min.   :  0.000   Min.   : 0.000000   Length:182849      Length:182849
##  1st Qu.:  3.000   1st Qu.: 0.000000   Class :character   Class :character
##  Median :  7.000   Median : 0.000000   Mode  :character   Mode  :character
##  Mean   :  7.568   Mean   : 0.007555
##  3rd Qu.: 10.000   3rd Qu.: 0.000000
##  Max.   :142.000   Max.   :10.020000
##    Crossing           Give_Way           Junction           No_Exit
##  Length:182849      Length:182849      Length:182849      Length:182849
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##    Railway            Roundabout          Station              Stop
##  Length:182849      Length:182849      Length:182849      Length:182849
##  Class :character   Class :character   Class :character   Class :character
```

```
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##  Traffic_Calming    Traffic_Signal     Turning_Loop       Sunrise_Sunset
##  Length:182849      Length:182849      Length:182849      Length:182849
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
```

```
#Checking for datatypes of each of the attributes in the dataset
sapply(Mva,class)
```

```
##          Severity        Start_Time          End_Time      Distance.mi.
##         "integer"       "character"       "character"         "numeric"
##       Description              Side              City            County
##       "character"       "character"       "character"       "character"
##             State           Country    Temperature.F.     Wind_Chill.F.
##       "character"       "character"         "numeric"         "numeric"
##       Humidity...      Pressure.in.    Visibility.mi.    Wind_Direction
##         "numeric"         "numeric"         "numeric"       "character"
##   Wind_Speed.mph. Precipitation.in. Weather_Condition              Bump
##         "numeric"         "numeric"       "character"       "character"
##          Crossing          Give_Way          Junction           No_Exit
##       "character"       "character"       "character"       "character"
##           Railway        Roundabout           Station              Stop
##       "character"       "character"       "character"       "character"
##   Traffic_Calming    Traffic_Signal      Turning_Loop    Sunrise_Sunset
##       "character"       "character"       "character"       "character"
```

```
# Creating new dataframe with only the numerical attributes to perform statistical functions
num<-Mva[,c(1,4,11:15,17,18)]

# Finding the correlation between all numerical variables
corr<-cor(num,method=c("pearson","kendall","spearman"))
corr
```

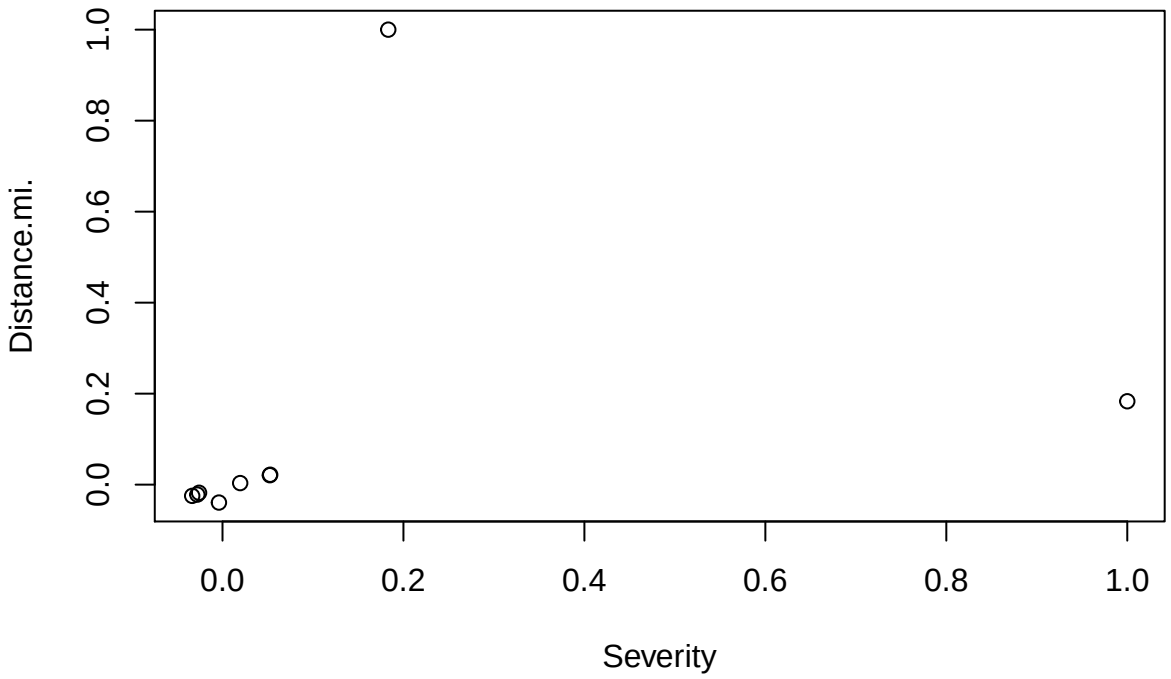
```
##                      Severity Distance.mi. Temperature.F. Wind_Chill.F.
## Severity           1.000000000   0.18320436    -0.02780004   -0.03350551
## Distance.mi.       0.183204361   1.00000000    -0.02185492   -0.02466257
## Temperature.F.    -0.027800040  -0.02185492     1.00000000    0.99375385
## Wind_Chill.F.     -0.033505511  -0.02466257     0.99375385    1.00000000
## Humidity...        0.052701523   0.02176980    -0.43135406   -0.41426578
## Pressure.in.      -0.003922202  -0.03934736     0.03946663    0.04070670
## Visibility.mi.    -0.025895193  -0.01784896     0.31676910    0.32580072
## Wind_Speed.mph.    0.052353286   0.02074942    -0.01090524   -0.06539002
## Precipitation.in.  0.019554182   0.00344414    -0.03308594   -0.03359791
##                   Humidity... Pressure.in. Visibility.mi. Wind_Speed.mph.
## Severity           0.05270152 -0.003922202    -0.02589519      0.05235329
## Distance.mi.       0.02176980 -0.039347359    -0.01784896      0.02074942
## Temperature.F.    -0.43135406  0.039466627     0.31676910     -0.01090524
## Wind_Chill.F.     -0.41426578  0.040706699     0.32580072     -0.06539002
## Humidity...        1.00000000  0.198936163    -0.43067894     -0.14819125
## Pressure.in.       0.19893616  1.000000000    -0.08965456     -0.04925739
```

```
## Visibility.mi.    -0.43067894 -0.089654562     1.00000000     -0.02254997
## Wind_Speed.mph.   -0.14819125 -0.049257386    -0.02254997      1.00000000
## Precipitation.in.  0.10380281  0.017843267    -0.14656459      0.03132604
##                   Precipitation.in.
## Severity                 0.01955418
## Distance.mi.             0.00344414
## Temperature.F.          -0.03308594
## Wind_Chill.F.           -0.03359791
## Humidity...              0.10380281
## Pressure.in.             0.01784327
## Visibility.mi.          -0.14656459
## Wind_Speed.mph.          0.03132604
## Precipitation.in.        1.00000000
```

```
# OR

#Plotting the correlation graph
library(corrplot)
```

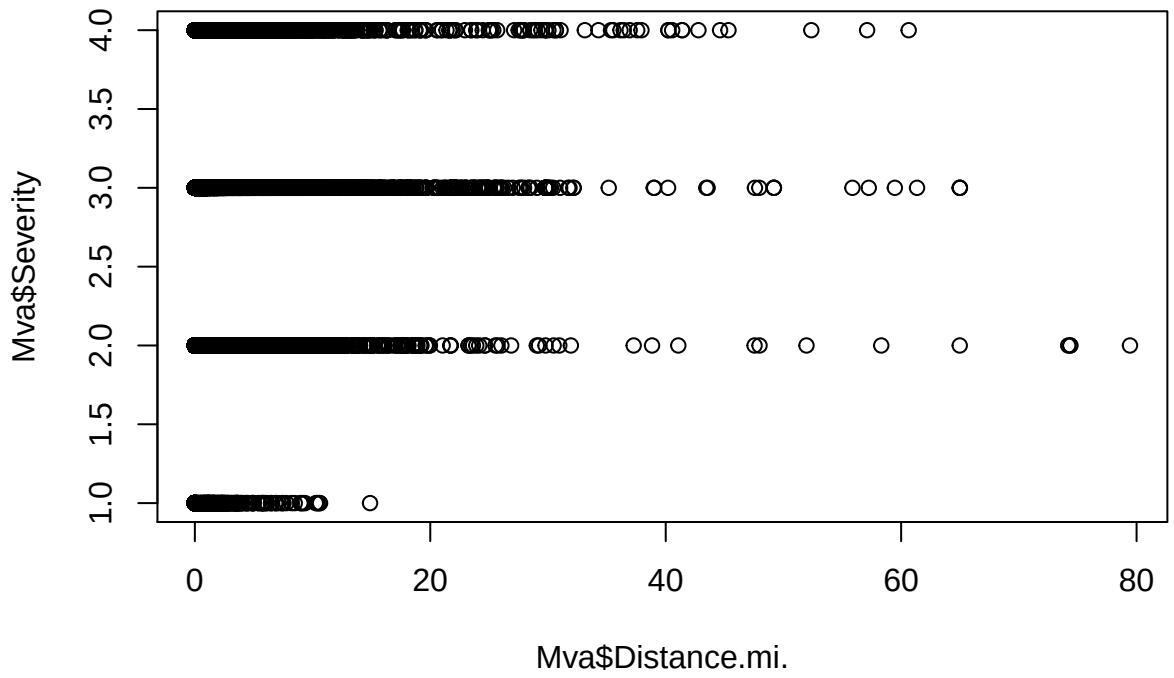
```
## corrplot 0.84 loaded
```

```
plot(corr)
```

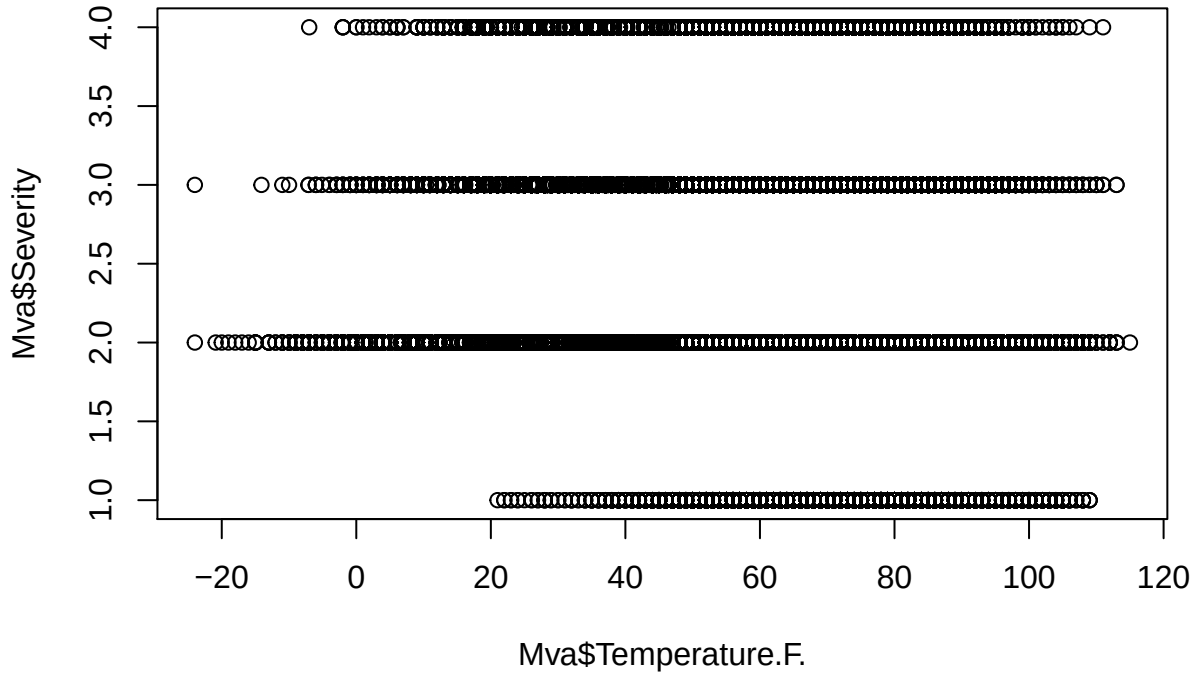



```
#We observe that there are strong correlations between Temp and visibility, wind chill and visibility,
#Humididty and pressure etc, strong neg corrs are observed between Humidity and wind chill for instance
# A higher pos value between 0 and 1 is positive corr and neg value between 0 and -1 is a neg corr



# DATA EXPLORATION AND VISUALIZATION  ##

#Ques 1. How are the numerical weather variables related to the KPI Severity of accident ??

## Plotting Scatter plots between each variable and the KPI(Severity)
```

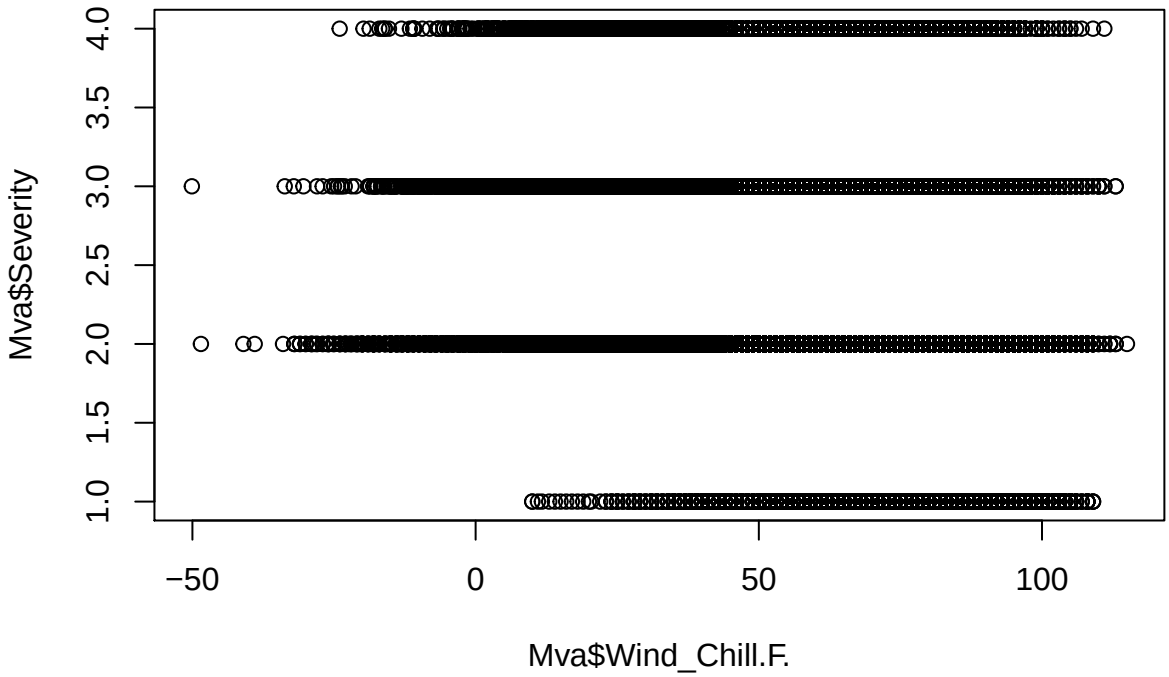
```r
plot(Mva$Distance.mi.,Mva$Severity)
```



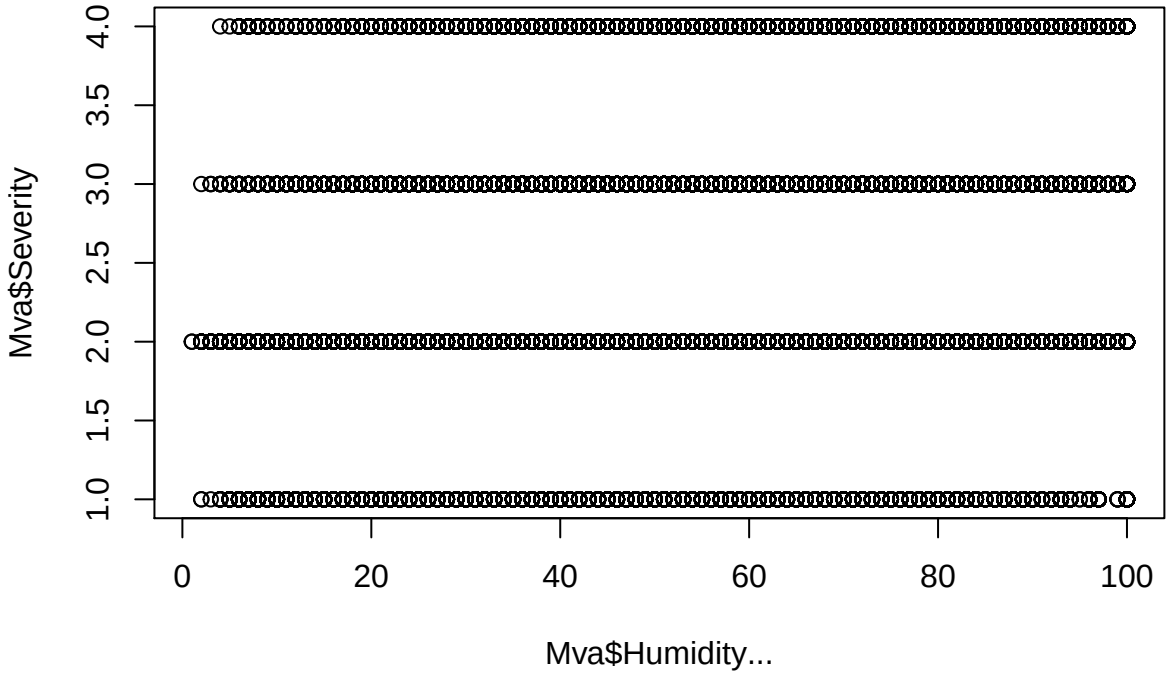

```r
#Some outliers are found in the distance column for distances larger than 20 mtrs, most categories of s

plot(Mva$Temperature.F.,Mva$Severity)
```



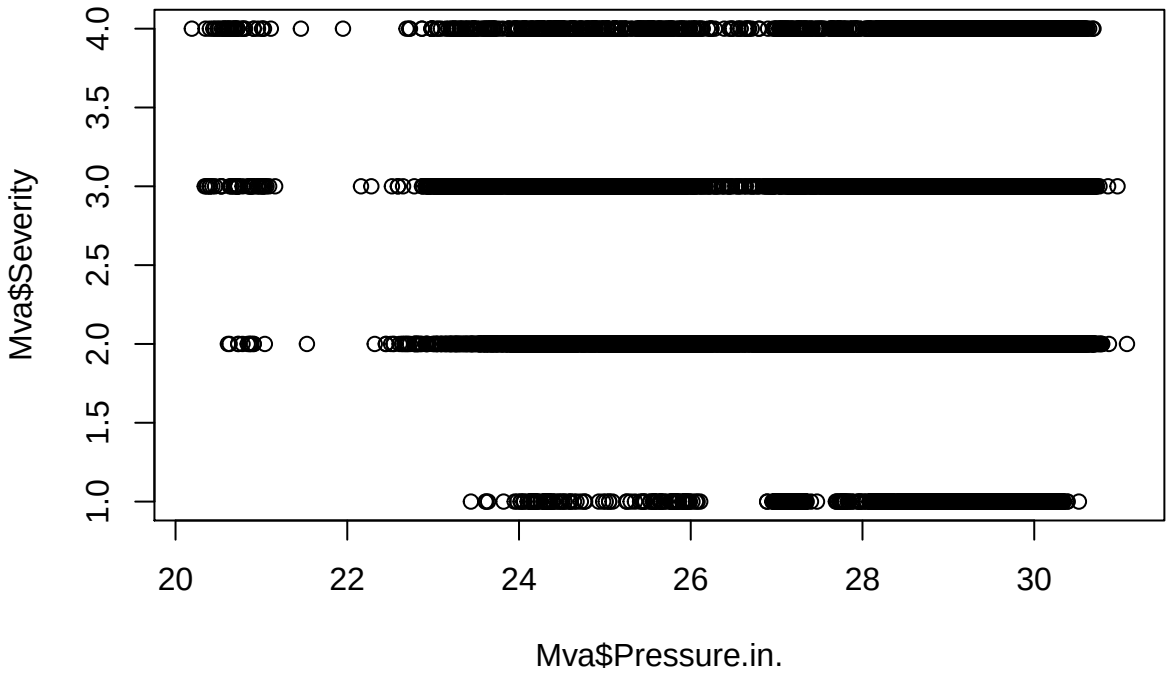

```r
#From the apparent density of the data points on the severity vs temp plot, for slight rise in temp the

plot(Mva$Wind_Chill.F.,Mva$Severity)
```



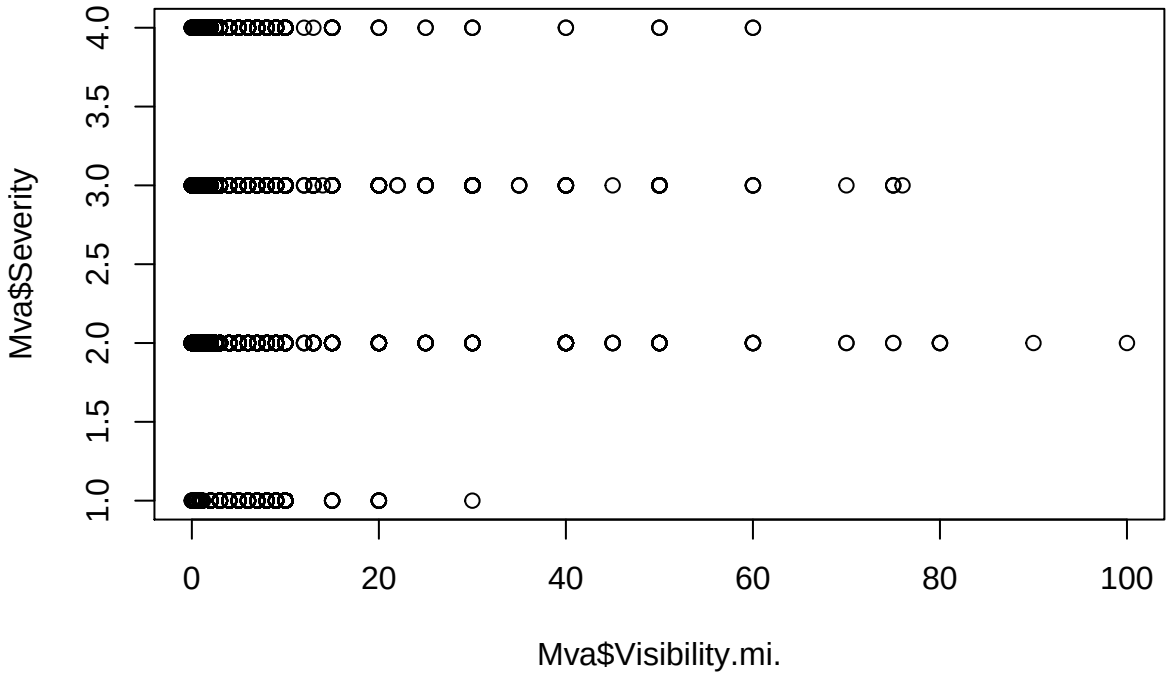

```
#A similar effect is observed , as wind chills temp rises severity is increasing , also no category 1 a

plot(Mva$Humidity...,Mva$Severity)
```



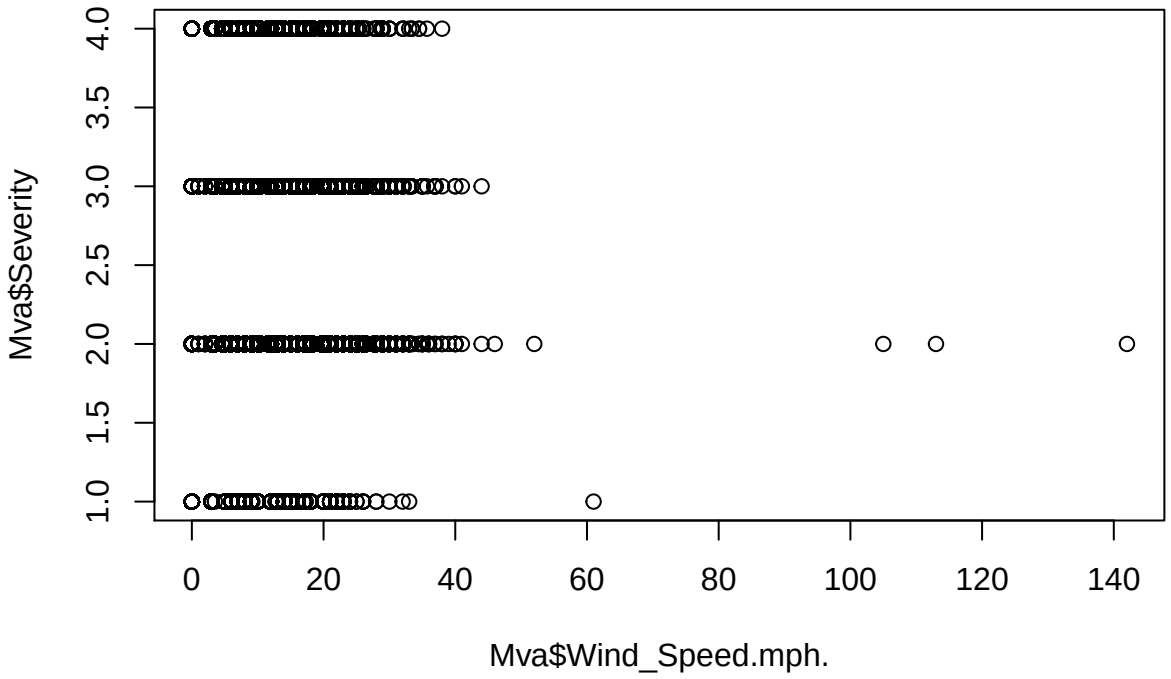

```
#Humidity seems to almost have no co relation with severity here

plot(Mva$Pressure.in.,Mva$Severity)
```



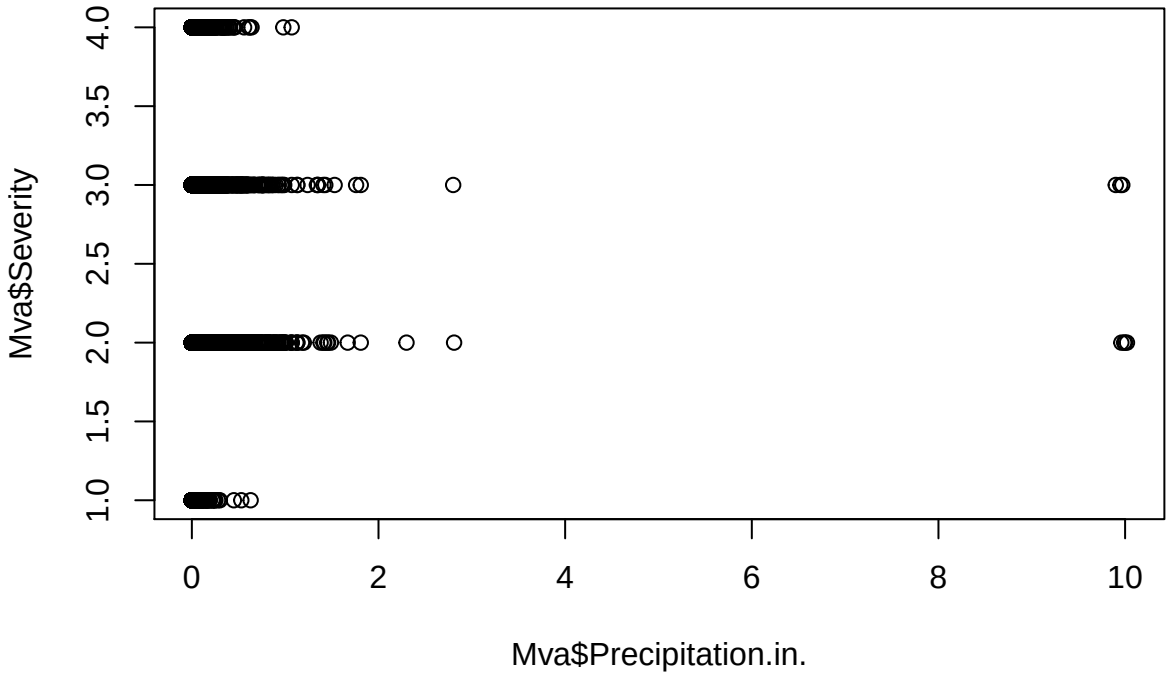

```
#No cat 1 accidents for pressures less than 23 inches, for other categories , the data seem pretty skew

plot(Mva$Visibility.mi.,Mva$Severity)
```



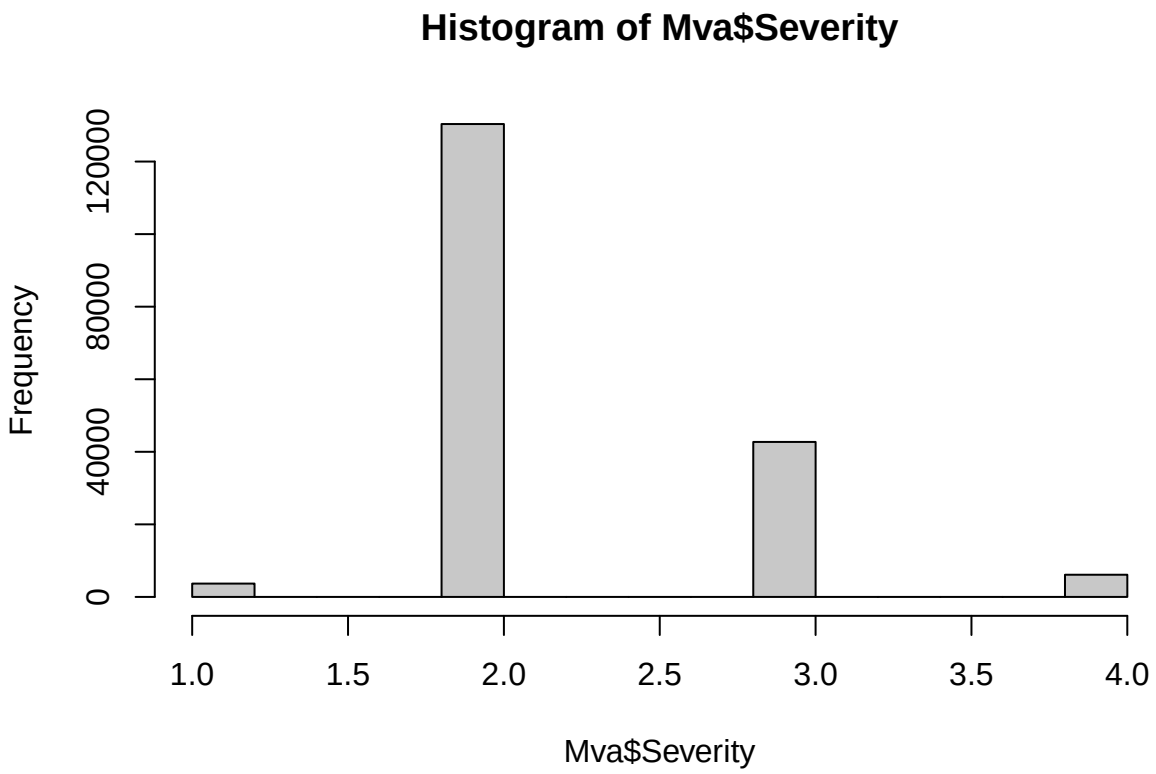

```
# Almost all categories of accidents have taken place when Visibility was 0, with few outliers in each

plot(Mva$Wind_Speed.mph.,Mva$Severity)
```



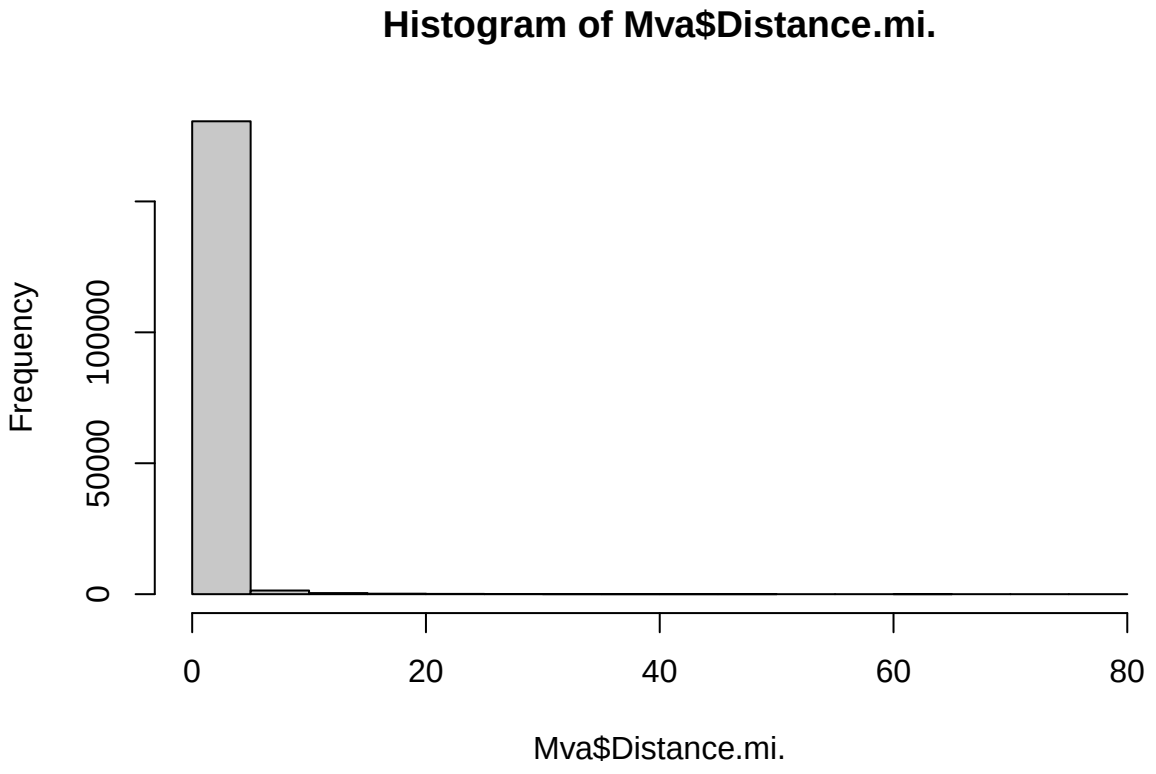

```
plot(Mva$Precipitation.in.,Mva$Severity)

#Scatterplots here show how the variables are distributed and their frequencies in each category of sev

#Ques 2. How are the attributes distributed, what values or ranges of each numerical attribute is more

#Plotting histograms
library(ggplot2)
```



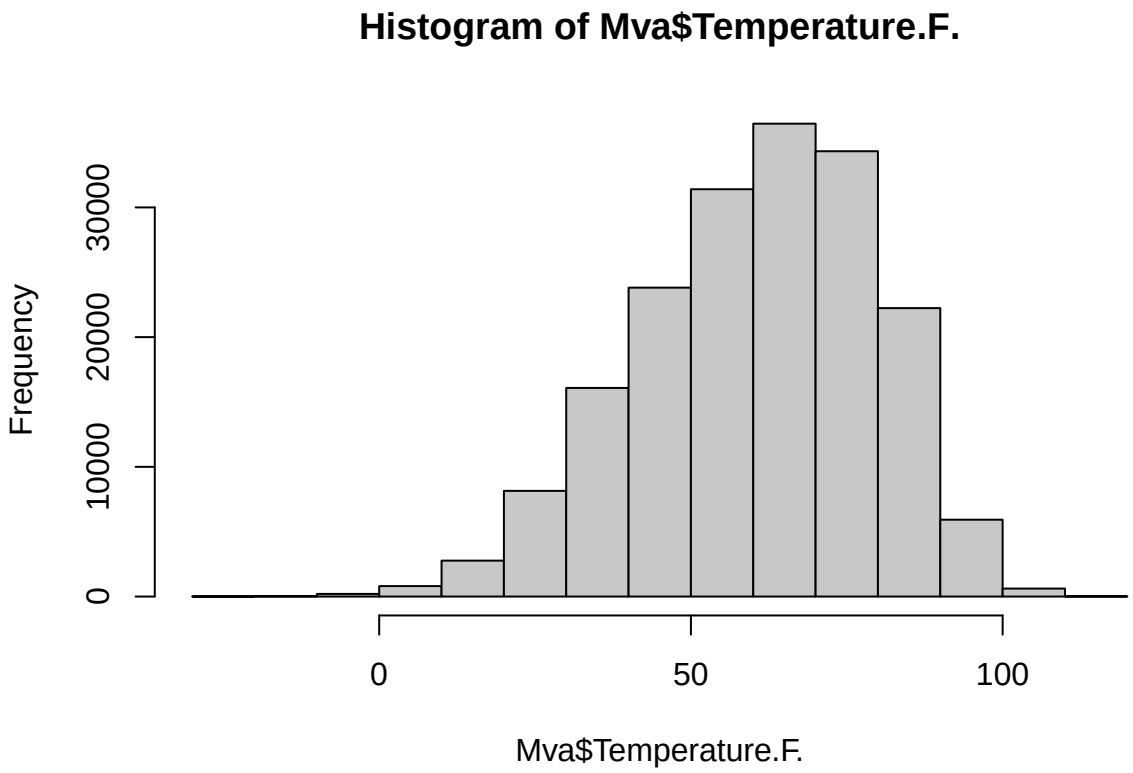

```
#Which was the category that most accidents fell under??
hist(Mva$Severity)
```



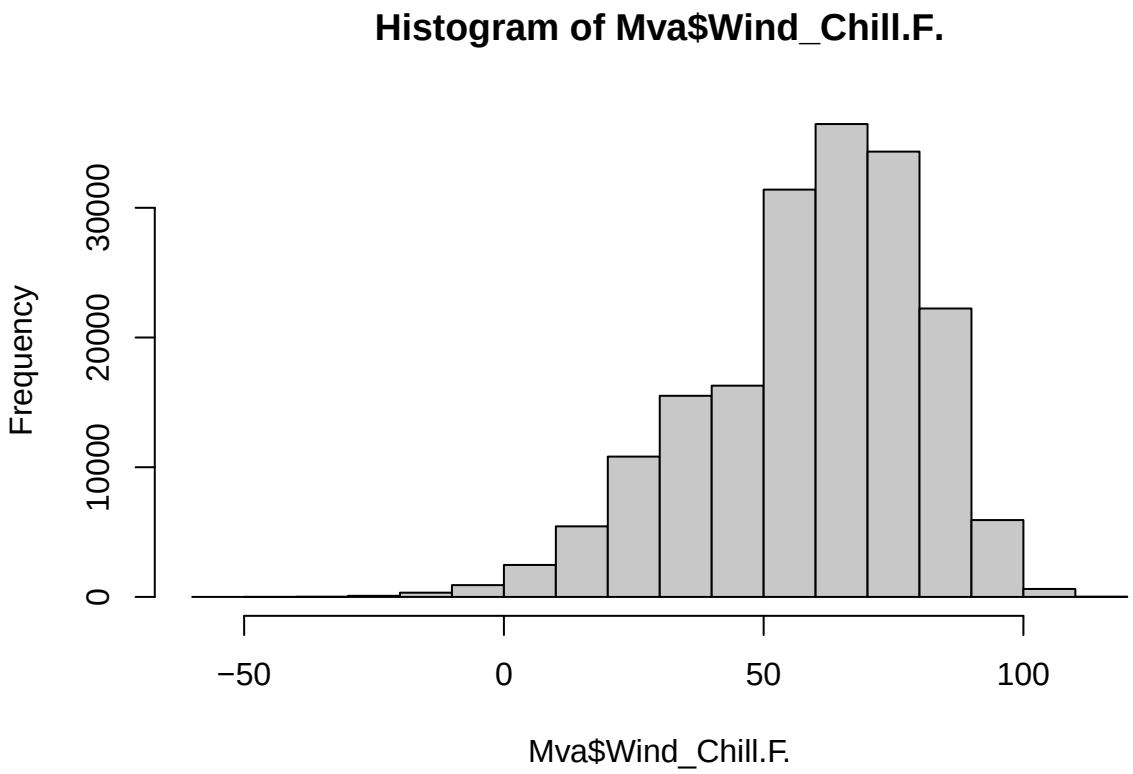

```
# Category 2 severity was most prevalent

#What was the distance distribution over which the accident took place??
hist(Mva$Distance.mi.)
```



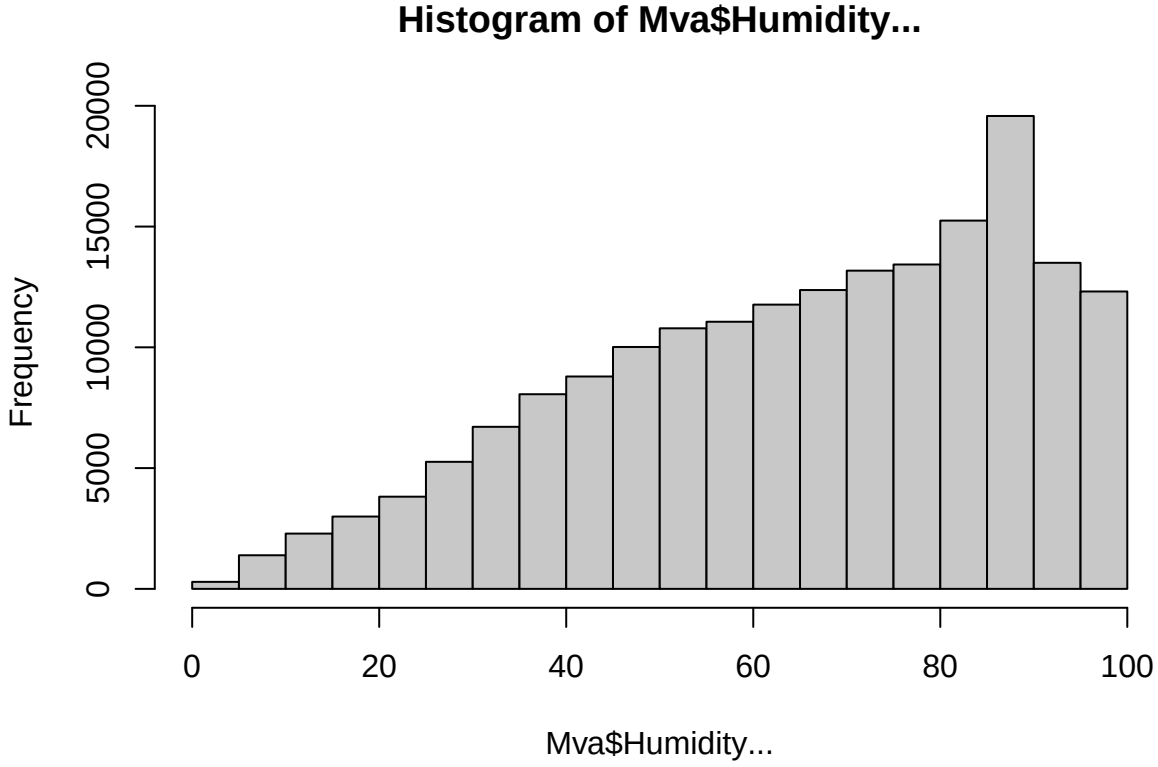
```r
#Mostly between 0 to 20 meters

# What temp contributed most to the accidents??
hist(Mva$Temperature.F.)
```



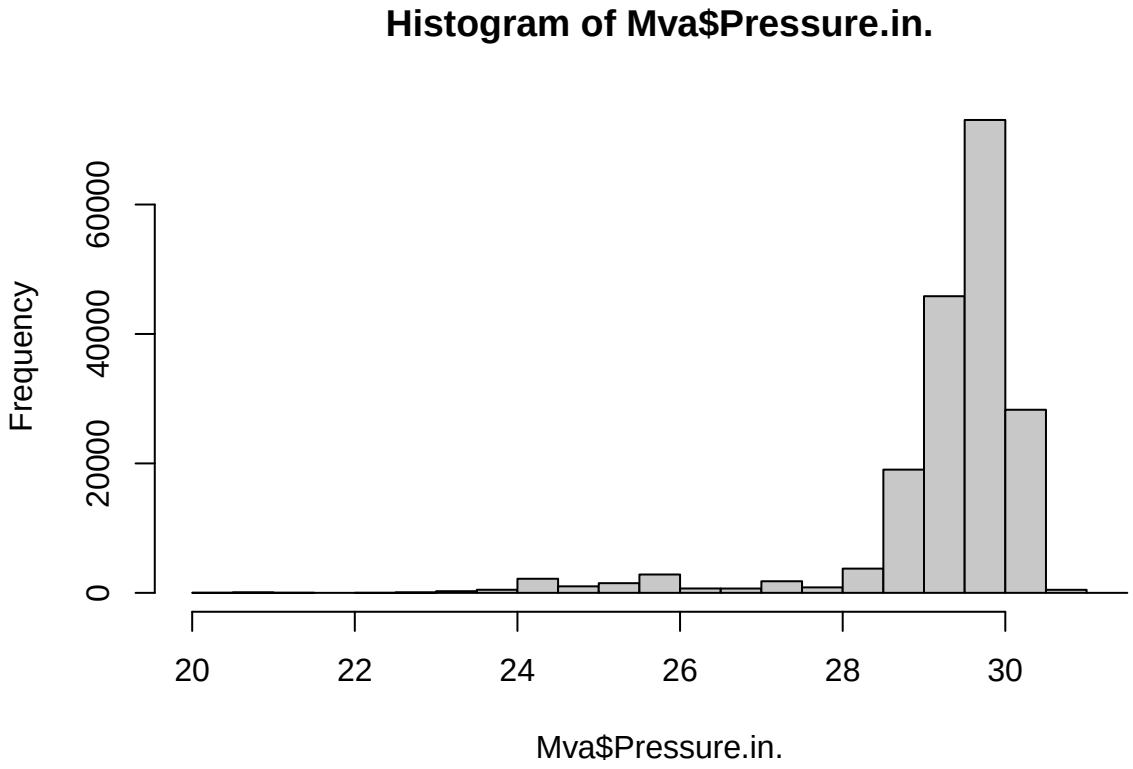

```r
# Most accidents took place when the temp was between 60-80 deg F

# How did wind chill contribute to the accident??
hist(Mva$Wind_Chill.F.)
```



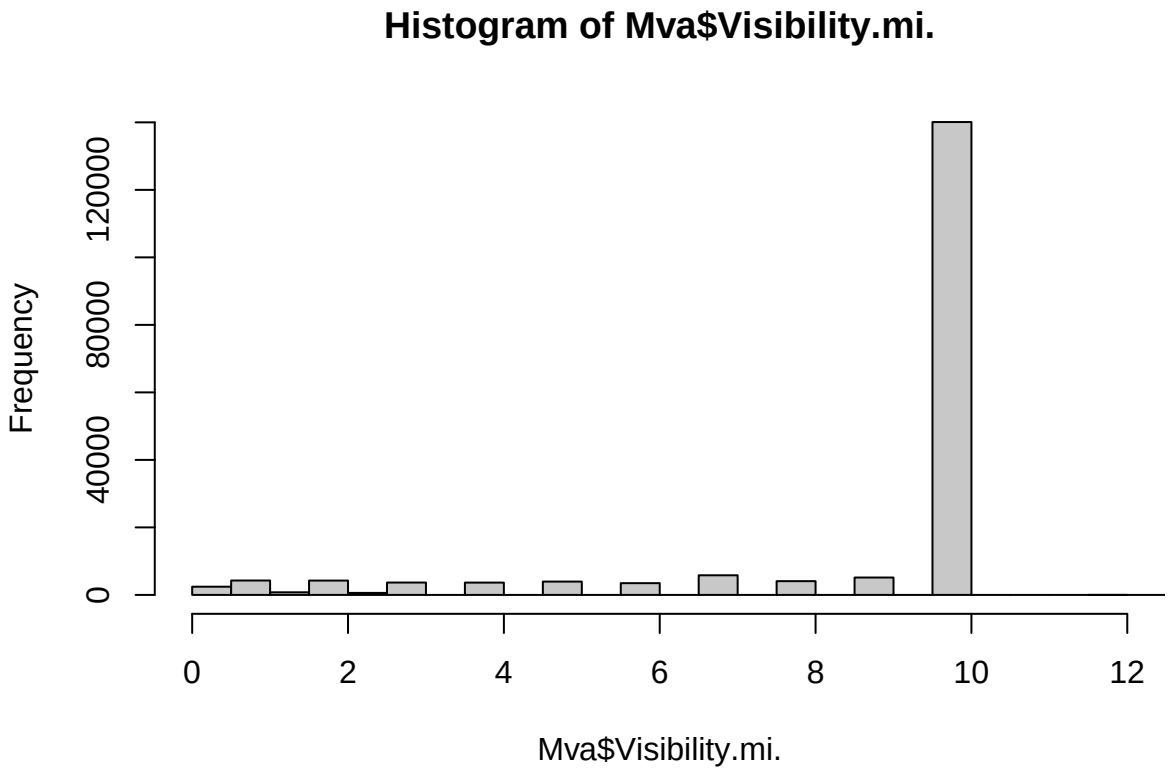

```r
#Most accs took place with wind chill in the range 50-100

# Contribution of Humidity??
hist(Mva$Humidity...)
```



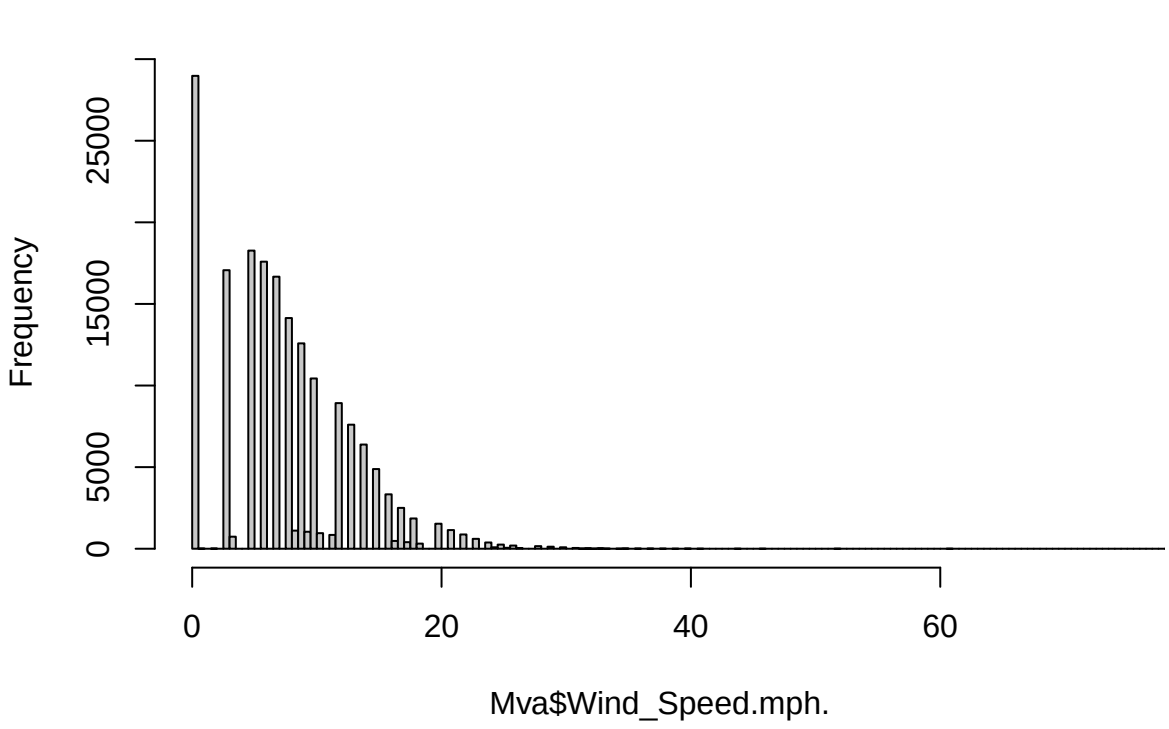
```r
#Shows a strong positive trend , as the humidity increased so did the number of accidents

#Pressure contribution??
hist(Mva$Pressure.in.)
```



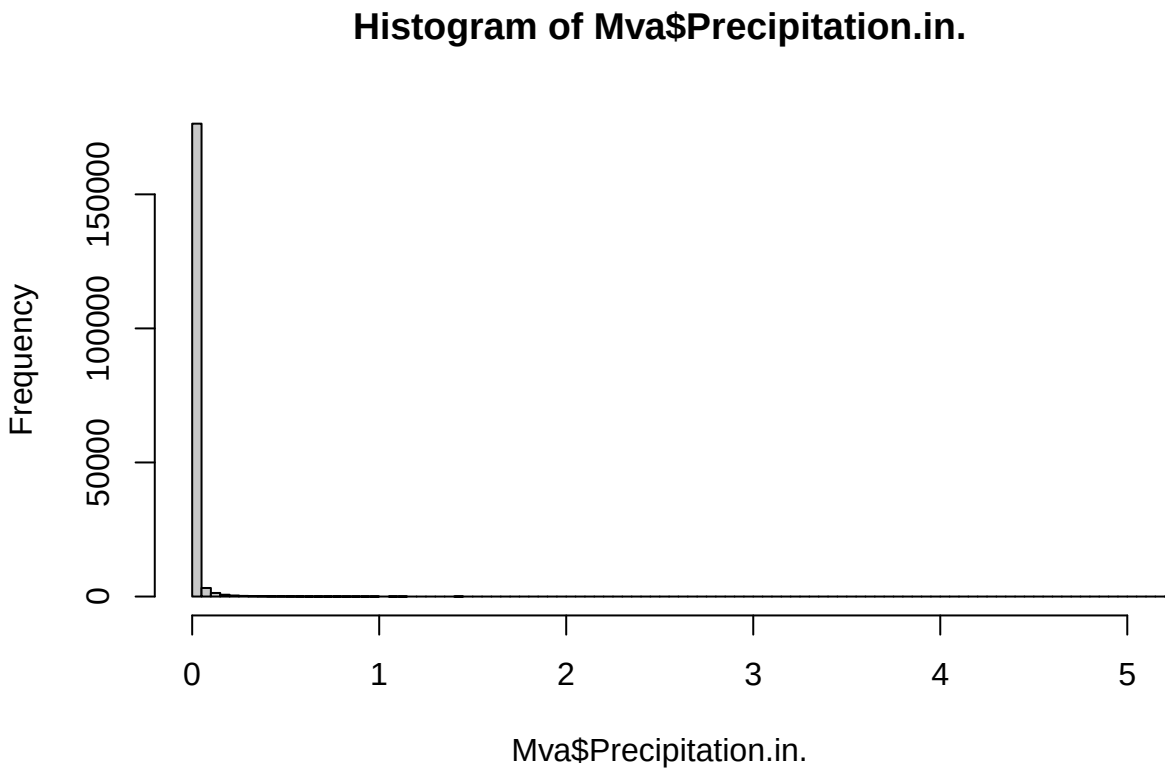

```r
#Again we see a positive relation, as the higher values of pressures show higher numbers of accidents

#Visibility vs no of accidents??
hist(Mva$Visibility.mi.,xlim=c(0,12),breaks=200)
```




```
# A low visibility  is the most prevalent for accident and thus has much more accidents associated with
#AS visibility increased accidents decreased

#Was Wind speed a factor in accident event??
hist(Mva$Wind_Speed.mph.,xlim=c(0,75),breaks=500)
```



```r
#Wind chills seem to be negatively related to accidents, maybe when high wind chills were present , les

#Effect of precipitation?
hist(Mva$Precipitation.in.,breaks=200,xlim=c(0,5))
```

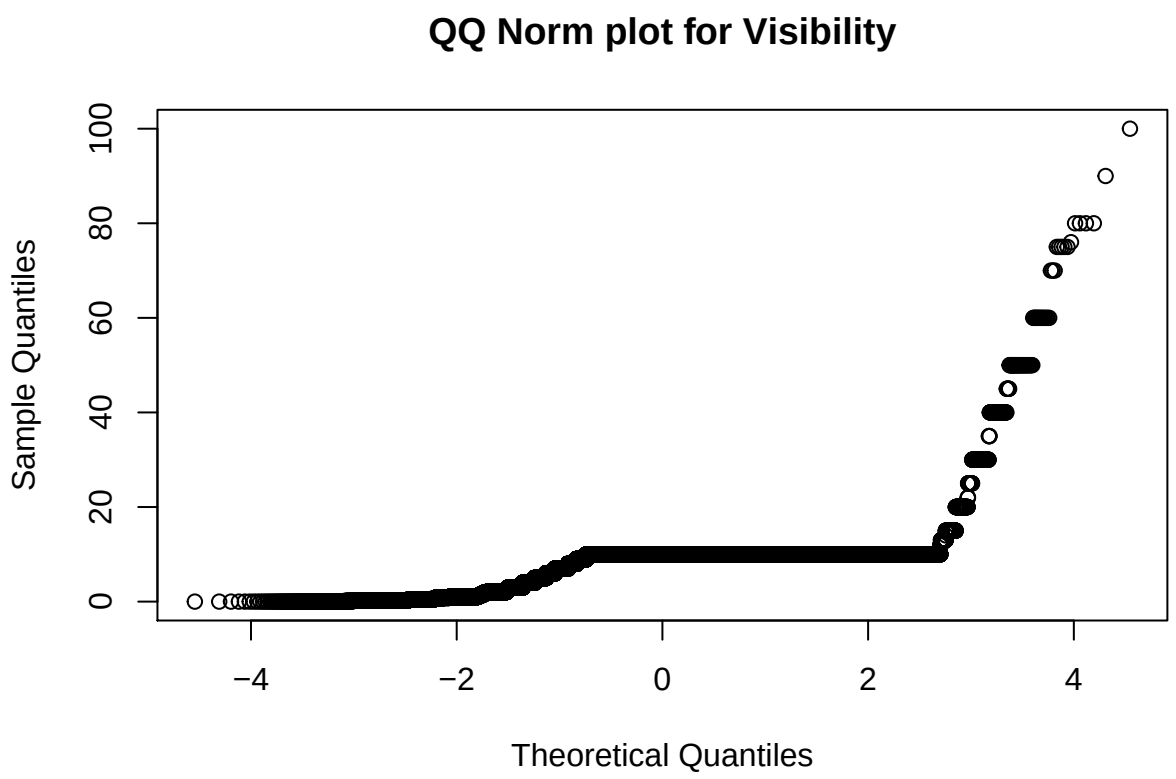



```r
#Precipitation shows no significant relation to no of accidents

# Histograms here show the frequencies of each attribute within a certain range,

#Finding covariance and mahalanobis, Euclidean distance
cov(num)
```

```
##                      Severity  Distance.mi. Temperature.F. Wind_Chill.F.
## Severity           0.308812204  0.1638066450    -0.29085445   -0.39486552
## Distance.mi.       0.163806645  2.5887908367    -0.66203474   -0.84153587
## Temperature.F.    -0.290854452 -0.6620347391   354.45910223  396.77804128
## Wind_Chill.F.     -0.394865518 -0.8415358735   396.77804128  449.75031319
## Humidity...        0.674941335  0.8072323952  -187.15980637 -202.46988132
## Pressure.in.      -0.002500267 -0.0726228340     0.85235831    0.99028626
## Visibility.mi.    -0.041726178 -0.0832728841    17.29291115   20.03456907
## Wind_Speed.mph.    0.158426351  0.1817986534    -1.11803257   -7.55150430
## Precipitation.in.  0.000814851  0.0004155474    -0.04671086   -0.05343051
##                   Humidity... Pressure.in. Visibility.mi. Wind_Speed.mph.
## Severity             0.6749413 -0.002500267    -0.04172618      0.15842635
## Distance.mi.         0.8072324 -0.072622834    -0.08327288      0.18179865
## Temperature.F.    -187.1598064  0.852358309    17.29291115     -1.11803257
## Wind_Chill.F.     -202.4698813  0.990286255    20.03456907     -7.55150430
## Humidity...        531.1182985  5.259185569   -28.78004693    -18.59749464
## Pressure.in.         5.2591856  1.315885952    -0.29821106     -0.30769237
## Visibility.mi.     -28.7800469 -0.298211062     8.40784040     -0.35606101
```

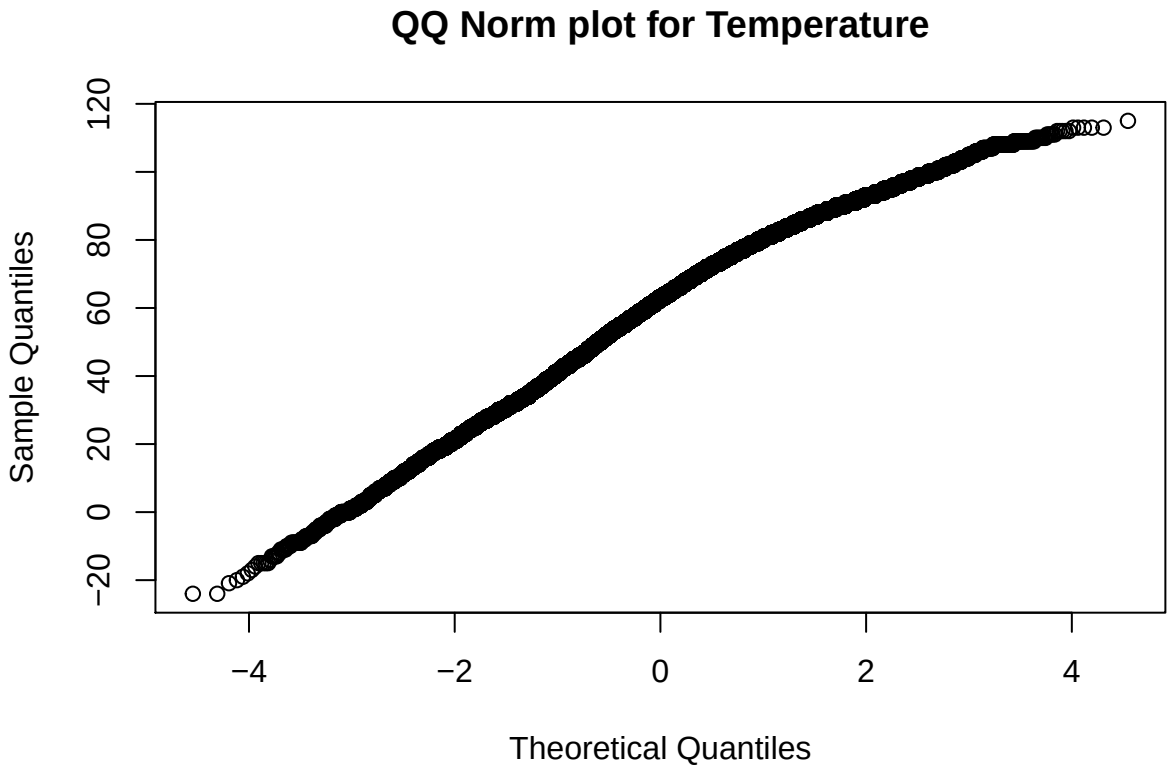
```
## Wind_Speed.mph.    -18.5974946 -0.307692373    -0.35606101     29.65326254
## Precipitation.in.    0.1793891  0.001534881    -0.03186857      0.01279184
##                   Precipitation.in.
## Severity              0.0008148510
## Distance.mi.          0.0004155474
## Temperature.F.       -0.0467108622
## Wind_Chill.F.        -0.0534305107
## Humidity...           0.1793891075
## Pressure.in.          0.0015348814
## Visibility.mi.       -0.0318685722
## Wind_Speed.mph.       0.0127918428
## Precipitation.in.     0.0056231887
```

```
#Again here we find strong positive relationships between Temp and wind chill,Temp and visibiltiy etc
#Strong neg relation between Humidity and visibility
# For the KPI that is severity, Humidity, wind speed,Distance were the attributes that showed slightly
#dist(num,method = "euclidean")
#mahalanobis(x=Mva$Distance.mi.,data.y=Mva$Temperature.F.)

## FINDING NORMALITY OF DATA ATTRIBUTES (NUMERICAL) ##

#Finding qqnorm normality in dataset, similarly will be plotted for all numerical attributes,(finding n

qqnorm(num[,c("Visibility.mi.")],main="QQ Norm plot for Visibility")
```

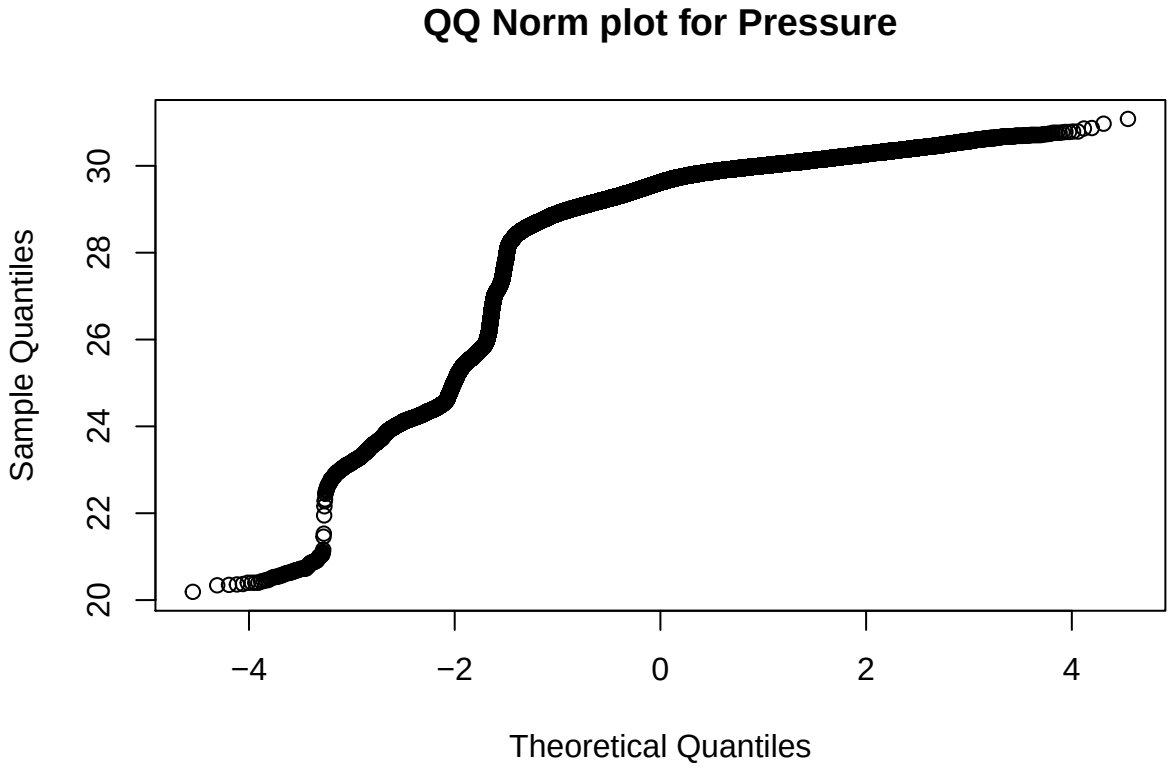



```
#Using the scale function to standardize the column values
Mva$Visibility.mi.<-scale(Mva$Visibility.mi.)
#Above plot for visibility shows that the data is not normal, and therefore would be an issue while
#Statistical testing and hence the visibility attribute needs to be normalized
```

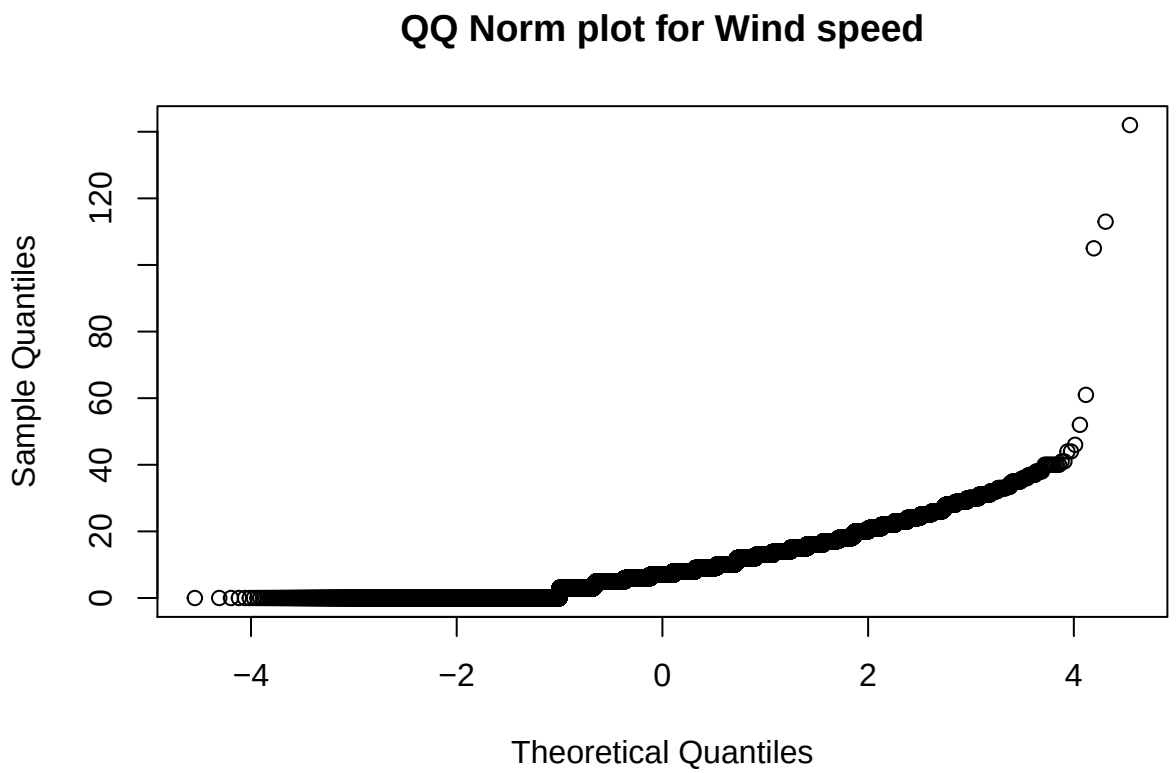
```
qqnorm(num[,c("Temperature.F.")],main="QQ Norm plot for Temperature")
```



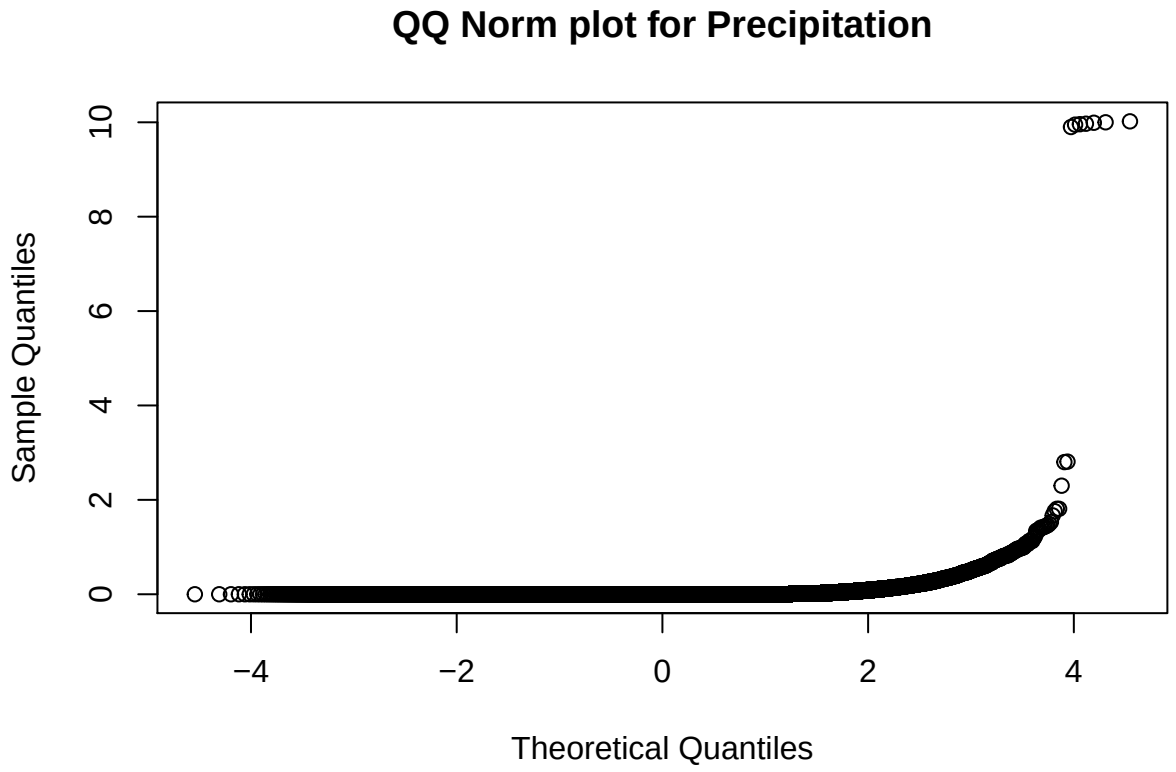

```
#The qq plot for temperature shows that the data is almost perfectly normal

qqnorm(num[,c("Pressure.in.")],main="QQ Norm plot for Pressure")
```



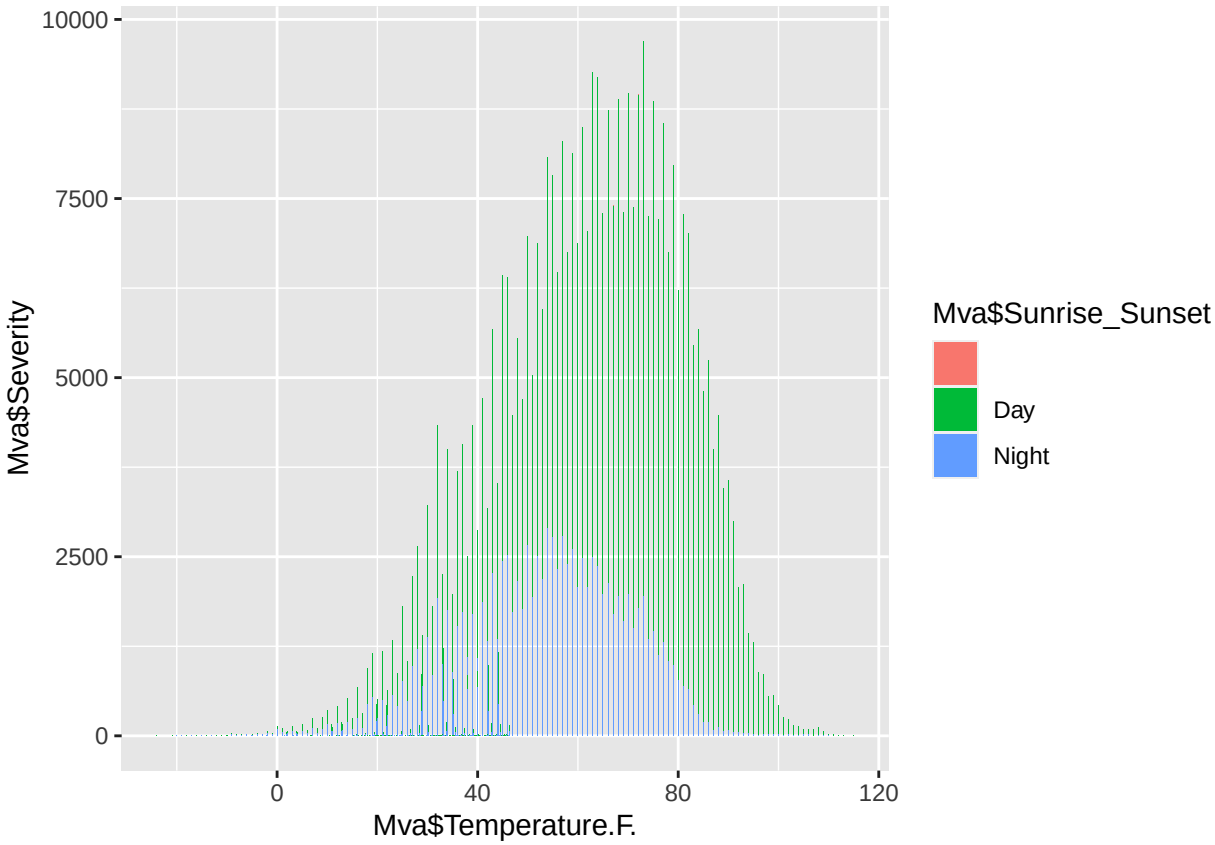
```
#The above plot also has a skewed distribution and needs to be normalized

qqnorm(num[,c("Wind_Speed.mph.")],main="QQ Norm plot for Wind speed")
```




```
#above plot shows slight skewness in the wind speed normality with presence of outliers that must be el

qqnorm(num[,c("Precipitation.in.")],main="QQ Norm plot for Precipitation")
```

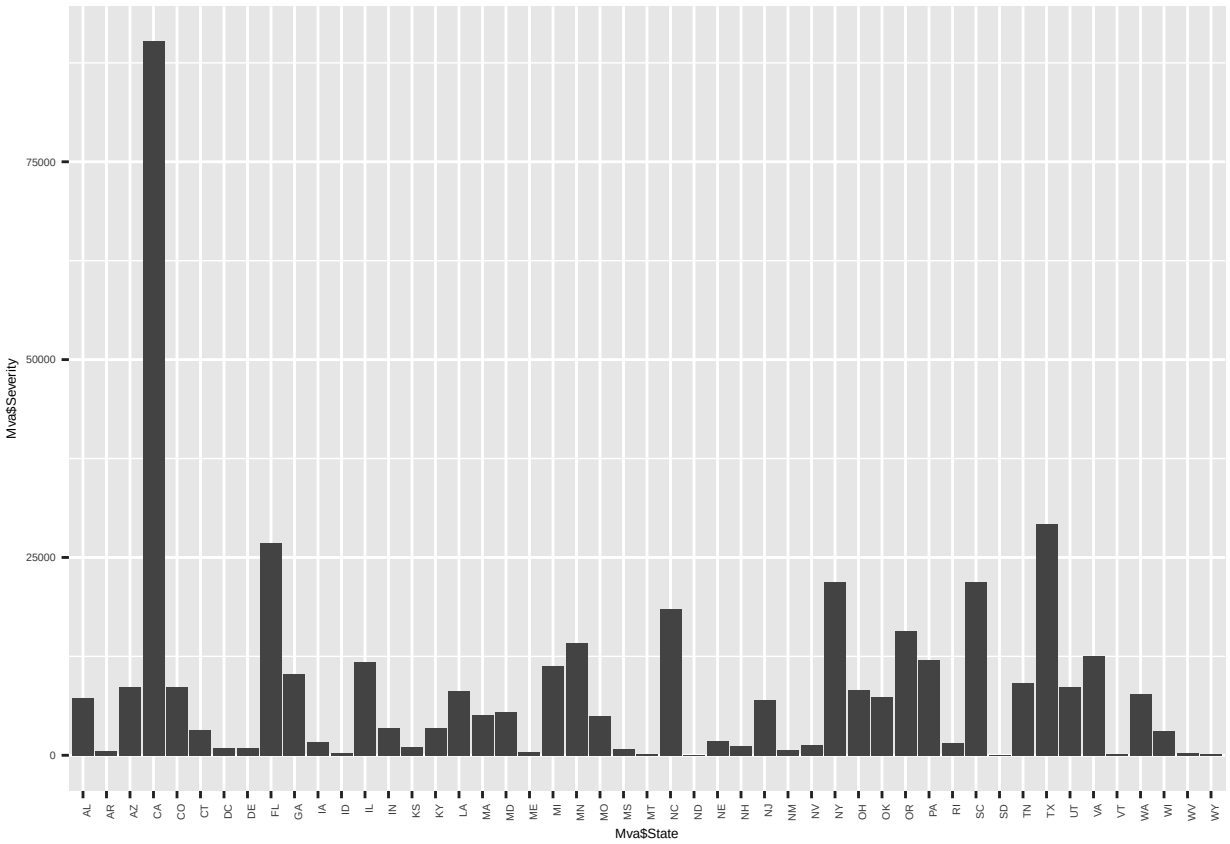



```
#Scaling the data
Mva$Precipitation.in.<-scale(Mva$Precipitation.in.)
#qqnorm(num[,c("Precipitation.in.")],main="QQ Norm plot for Precipitation")
#Above plot shows presence of outliers and slight skewness



## CATEGORICAL VARIABLE EXPLORATION ##

library(ggplot2)

#Some examples of observations noted

#1. Sunrise_Sunset : whether accidents happened more at night or day
ggplot(Mva,aes(fill=Mva$Sunrise_Sunset,y=Mva$Severity,x=Mva$Temperature.F.))+
  geom_bar(stat='identity')
```

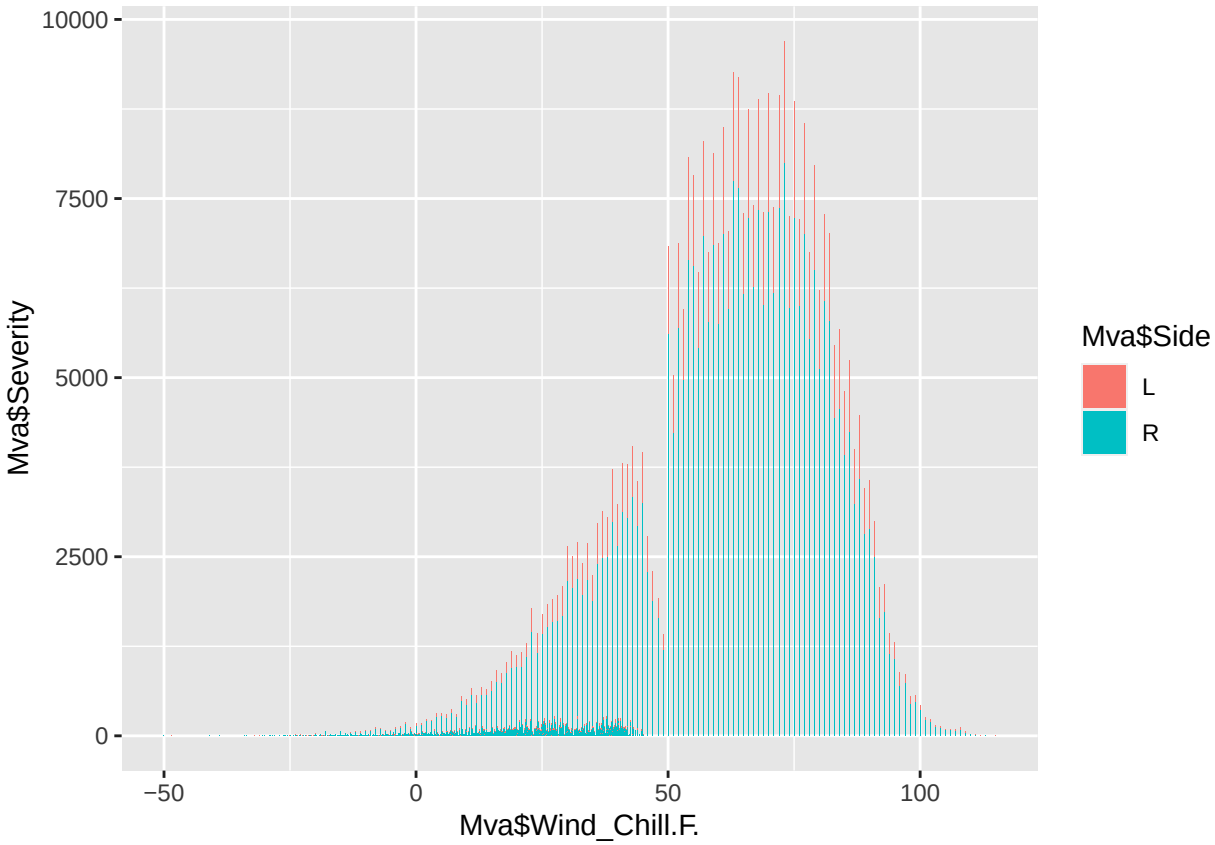



```
#Above graph shows that for the normally distributed temperature data,a high majority of the road accid
#Also, the peak was around 60 degrees F

#2. State :exploring which states had the most accidents and at what severity
ggplot(Mva, aes(x=Mva$State,y=Mva$Severity)) +
  geom_histogram(stat='identity',binwidth=50)+
  theme(text = element_text(size=5),
        axis.text.x = element_text(angle=90, hjust=1))
```

```
## Warning: Ignoring unknown parameters: binwidth, bins, pad
```

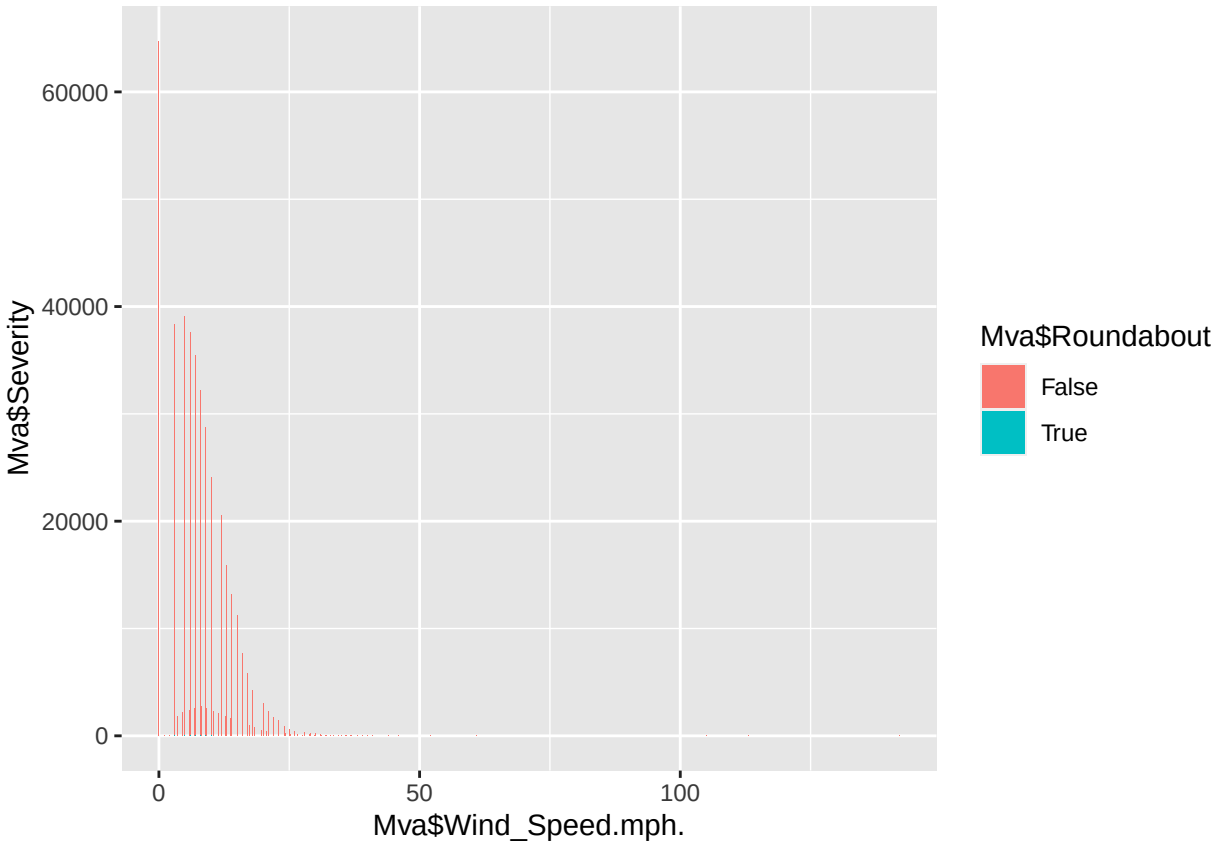



```
#Here we observe that the most number of accidents took place in the state of California, Texas and Flo

#Ques 3. Side: To find which side of the road was more prone to the event of accident.
ggplot(Mva, aes(fill=Mva$Side, y=Mva$Severity, x=Mva$Wind_Chill.F.)) +
  geom_bar(position="stack", stat="identity")
```




```
#We observe that most accidents took place on the right side of the road.

#Ques 4. To fond whether the roundabout presence or absence was significant for the accident.
ggplot(Mva, aes(fill=Mva$Roundabout, y=Mva$Severity, x=Mva$Wind_Speed.mph.)) +
  geom_histogram(position="stack", stat="identity",xlim=c(0,1))
```

```
## Warning: Ignoring unknown parameters: binwidth, bins, pad, xlim
```




```
#Here we observe that mostly the roundabout was absent when the accident took place.


## PERFORMING HYPOTHESIS TESTS ## will be expanded more after further processing and normalizing of the

#t tests here determine whether the null hypothesis that the mean of the two samples is equal will be r
# Performing t-tests on various combinations of variables

t.test(Mva$Humidity...~Mva$Station)
```

```
##
##  Welch Two Sample t-test
##
## data:  Mva$Humidity... by Mva$Station
## t = 2.3901, df = 3848.4, p-value = 0.01689
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.155066 1.570797
## sample estimates:
## mean in group False  mean in group True
##            65.54438            64.68145
```

```
# The p value comes out to be really small therefore the null hypothesis that the mean of both samples

t.test(Mva$Severity~Mva$Side,data=Mva)
```

```
##
##  Welch Two Sample t-test
```

```
##
## data:  Mva$Severity by Mva$Side
## t = -66.356, df = 59222, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.2013200 -0.1897682
## sample estimates:
## mean in group L mean in group R
##        2.121470        2.317015
```

```
#Here again it is rejected, since p-value is extremely small
```