instructions

Analysis of weather data

This project involves exploring the U.S. National Oceanic and Atmospheric Administration's (NOAA) storm database. This database tracks characteristics of major storms and weather events in the United States, including when and where they occur, as well as estimates of any fatalities, injuries, and property damage

First clean the environment and setup the working directory:

```
getwd()
```

```
## [1] "C:/Users/saeed/Desktop/hti/programnig/R/ass.8"
```

```
data<- read.csv("C:/Users/saeed/Desktop/hti/programnig/R/ass.8/repdata_data_StormData.csv")
```

Loading the used libraies:

```
library(dplyr)
```

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

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

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

```
library(tidyr)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'

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

```
library(ggplot2)
```

Finding the heads of the data:

```
head(data)
```

```
##   STATE__           BGN_DATE BGN_TIME TIME_ZONE COUNTY COUNTYNAME STATE  EVTYPE
## 1       1  4/18/1950 0:00:00     0130       CST     97     MOBILE    AL TORNADO
## 2       1  4/18/1950 0:00:00     0145       CST      3    BALDWIN    AL TORNADO
## 3       1  2/20/1951 0:00:00     1600       CST     57    FAYETTE    AL TORNADO
## 4       1   6/8/1951 0:00:00     0900       CST     89    MADISON    AL TORNADO
## 5       1 11/15/1951 0:00:00     1500       CST     43    CULLMAN    AL TORNADO
## 6       1 11/15/1951 0:00:00     2000       CST     77 LAUDERDALE    AL TORNADO
##   BGN_RANGE BGN_AZI BGN_LOCATI END_DATE END_TIME COUNTY_END COUNTYENDN
## 1         0                                               0         NA
## 2         0                                               0         NA
## 3         0                                               0         NA
## 4         0                                               0         NA
## 5         0                                               0         NA
## 6         0                                               0         NA
##   END_RANGE END_AZI END_LOCATI LENGTH WIDTH F MAG FATALITIES INJURIES PROPDMG
## 1         0                      14.0   100 3   0          0       15    25.0
## 2         0                       2.0   150 2   0          0        0     2.5
## 3         0                       0.1   123 2   0          0        2    25.0
## 4         0                       0.0   100 2   0          0        2     2.5
## 5         0                       0.0   150 2   0          0        2     2.5
## 6         0                       1.5   177 2   0          0        6     2.5
##   PROPDMGEXP CROPDMG CROPDMGEXP WFO STATEOFFIC ZONENAMES LATITUDE LONGITUDE
## 1          K       0                                         3040      8812
## 2          K       0                                         3042      8755
## 3          K       0                                         3340      8742
## 4          K       0                                         3458      8626
## 5          K       0                                         3412      8642
## 6          K       0                                         3450      8748
##   LATITUDE_E LONGITUDE_ REMARKS REFNUM
## 1       3051       8806              1
## 2          0          0              2
## 3          0          0              3
## 4          0          0              4
## 5          0          0              5
## 6          0          0              6
```

Finding the summary of the data:

```
summary(data)
```

```
##     STATE__       BGN_DATE           BGN_TIME          TIME_ZONE
##  Min.   : 1.0   Length:902297      Length:902297      Length:902297
##  1st Qu.:19.0   Class :character   Class :character   Class :character
```

```
##  Median :30.0   Mode  :character   Mode  :character   Mode  :character
##  Mean   :31.2
##  3rd Qu.:45.0
##  Max.   :95.0
##
##      COUNTY       COUNTYNAME           STATE              EVTYPE
##  Min.   :  0.0   Length:902297      Length:902297      Length:902297
##  1st Qu.: 31.0   Class :character   Class :character   Class :character
##  Median : 75.0   Mode  :character   Mode  :character   Mode  :character
##  Mean   :100.6
##  3rd Qu.:131.0
##  Max.   :873.0
##
##    BGN_RANGE          BGN_AZI           BGN_LOCATI          END_DATE
##  Min.   :   0.000   Length:902297      Length:902297      Length:902297
##  1st Qu.:   0.000   Class :character   Class :character   Class :character
##  Median :   0.000   Mode  :character   Mode  :character   Mode  :character
##  Mean   :   1.484
##  3rd Qu.:   1.000
##  Max.   :3749.000
##
##    END_TIME           COUNTY_END COUNTYENDN       END_RANGE
##  Length:902297      Min.   :0    Mode:logical   Min.   :  0.0000
##  Class :character   1st Qu.:0    NA's:902297    1st Qu.:  0.0000
##  Mode  :character   Median :0                   Median :  0.0000
##                     Mean   :0                   Mean   :  0.9862
##                     3rd Qu.:0                   3rd Qu.:  0.0000
##                     Max.   :0                   Max.   :925.0000
##
##    END_AZI           END_LOCATI            LENGTH              WIDTH
##  Length:902297      Length:902297      Min.   :   0.0000   Min.   :   0.000
##  Class :character   Class :character   1st Qu.:   0.0000   1st Qu.:   0.000
##  Mode  :character   Mode  :character   Median :   0.0000   Median :   0.000
##                                        Mean   :   0.2301   Mean   :   7.503
##                                        3rd Qu.:   0.0000   3rd Qu.:   0.000
##                                        Max.   :2315.0000   Max.   :4400.000
##
##        F               MAG            FATALITIES          INJURIES
##  Min.   :0.0      Min.   :    0.0   Min.   :  0.0000   Min.   :   0.0000
##  1st Qu.:0.0      1st Qu.:    0.0   1st Qu.:  0.0000   1st Qu.:   0.0000
##  Median :1.0      Median :   50.0   Median :  0.0000   Median :   0.0000
##  Mean   :0.9      Mean   :   46.9   Mean   :  0.0168   Mean   :   0.1557
##  3rd Qu.:1.0      3rd Qu.:   75.0   3rd Qu.:  0.0000   3rd Qu.:   0.0000
##  Max.   :5.0      Max.   :22000.0   Max.   :583.0000   Max.   :1700.0000
##  NA's   :843563
##     PROPDMG          PROPDMGEXP           CROPDMG          CROPDMGEXP
##  Min.   :   0.00   Length:902297      Min.   :  0.000   Length:902297
##  1st Qu.:   0.00   Class :character   1st Qu.:  0.000   Class :character
##  Median :   0.00   Mode  :character   Median :  0.000   Mode  :character
##  Mean   :  12.06                      Mean   :  1.527
##  3rd Qu.:   0.50                      3rd Qu.:  0.000
##  Max.   :5000.00                      Max.   :990.000
##
##      WFO             STATEOFFIC         ZONENAMES            LATITUDE
```

```
##  Length:902297      Length:902297      Length:902297      Min.   :   0
##  Class :character   Class :character   Class :character   1st Qu.:2802
##  Mode  :character   Mode  :character   Mode  :character   Median :3540
##                                                           Mean   :2875
##                                                           3rd Qu.:4019
##                                                           Max.   :9706
##                                                           NA's   :47
##    LONGITUDE        LATITUDE_E     LONGITUDE_       REMARKS
##  Min.   :-14451   Min.   :   0   Min.   :-14455   Length:902297
##  1st Qu.:  7247   1st Qu.:   0   1st Qu.:     0   Class :character
##  Median :  8707   Median :   0   Median :     0   Mode  :character
##  Mean   :  6940   Mean   :1452   Mean   :  3509
##  3rd Qu.:  9605   3rd Qu.:3549   3rd Qu.:  8735
##  Max.   : 17124   Max.   :9706   Max.   :106220
##                   NA's   :40
##      REFNUM
##  Min.   :     1
##  1st Qu.:225575
##  Median :451149
##  Mean   :451149
##  3rd Qu.:676723
##  Max.   :902297
##
```

Finding the structure of the data:

```
str(data)
```

```
## 'data.frame':    902297 obs. of  37 variables:
##  $ STATE__   : num  1 1 1 1 1 1 1 1 1 1 ...
##  $ BGN_DATE  : chr  "4/18/1950 0:00:00" "4/18/1950 0:00:00" "2/20/1951 0:00:00" "6/8/1951 0:00:00" .
##  $ BGN_TIME  : chr  "0130" "0145" "1600" "0900" ...
##  $ TIME_ZONE : chr  "CST" "CST" "CST" "CST" ...
##  $ COUNTY    : num  97 3 57 89 43 77 9 123 125 57 ...
##  $ COUNTYNAME: chr  "MOBILE" "BALDWIN" "FAYETTE" "MADISON" ...
##  $ STATE     : chr  "AL" "AL" "AL" "AL" ...
##  $ EVTYPE    : chr  "TORNADO" "TORNADO" "TORNADO" "TORNADO" ...
##  $ BGN_RANGE : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ BGN_AZI   : chr  "" "" "" "" ...
##  $ BGN_LOCATI: chr  "" "" "" "" ...
##  $ END_DATE  : chr  "" "" "" "" ...
##  $ END_TIME  : chr  "" "" "" "" ...
##  $ COUNTY_END: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ COUNTYENDN: logi  NA NA NA NA NA NA ...
##  $ END_RANGE : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ END_AZI   : chr  "" "" "" "" ...
##  $ END_LOCATI: chr  "" "" "" "" ...
##  $ LENGTH    : num  14 2 0.1 0 0 1.5 1.5 0 3.3 2.3 ...
##  $ WIDTH     : num  100 150 123 100 150 177 33 33 100 100 ...
##  $ F         : int  3 2 2 2 2 2 2 1 3 3 ...
##  $ MAG       : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ FATALITIES: num  0 0 0 0 0 0 0 0 1 0 ...
```

```
##  $ INJURIES  : num  15 0 2 2 2 6 1 0 14 0 ...
##  $ PROPDMG   : num  25 2.5 25 2.5 2.5 2.5 2.5 2.5 25 25 ...
##  $ PROPDMGEXP: chr  "K" "K" "K" "K" ...
##  $ CROPDMG   : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ CROPDMGEXP: chr  "" "" "" "" ...
##  $ WFO       : chr  "" "" "" "" ...
##  $ STATEOFFIC: chr  "" "" "" "" ...
##  $ ZONENAMES : chr  "" "" "" "" ...
##  $ LATITUDE  : num  3040 3042 3340 3458 3412 ...
##  $ LONGITUDE : num  8812 8755 8742 8626 8642 ...
##  $ LATITUDE_E: num  3051 0 0 0 0 ...
##  $ LONGITUDE_: num  8806 0 0 0 0 ...
##  $ REMARKS   : chr  "" "" "" "" ...
##  $ REFNUM    : num  1 2 3 4 5 6 7 8 9 10 ...
```

Calculate the fatalities and injuries seperately:

```
#the Fatalities
totalFatalities <- aggregate(data$FATALITIES, by = list(data$EVTYPE), "sum")
names(totalFatalities) <- c("Event", "Fatalities")
totalFatalitiesSorted <- totalFatalities[order(-totalFatalities$Fatalities), ][1:20, ]
totalFatalitiesSorted
```

```
##                       Event Fatalities
## 834                 TORNADO       5633
## 130          EXCESSIVE HEAT       1903
## 153             FLASH FLOOD        978
## 275                    HEAT        937
## 464               LIGHTNING        816
## 856               TSTM WIND        504
## 170                   FLOOD        470
## 585             RIP CURRENT        368
## 359               HIGH WIND        248
## 19                AVALANCHE        224
## 972            WINTER STORM        206
## 586            RIP CURRENTS        204
## 278               HEAT WAVE        172
## 140            EXTREME COLD        160
## 760       THUNDERSTORM WIND        133
## 310               HEAVY SNOW        127
## 141 EXTREME COLD/WIND CHILL        125
## 676             STRONG WIND        103
## 30                 BLIZZARD        101
## 350               HIGH SURF        101
```

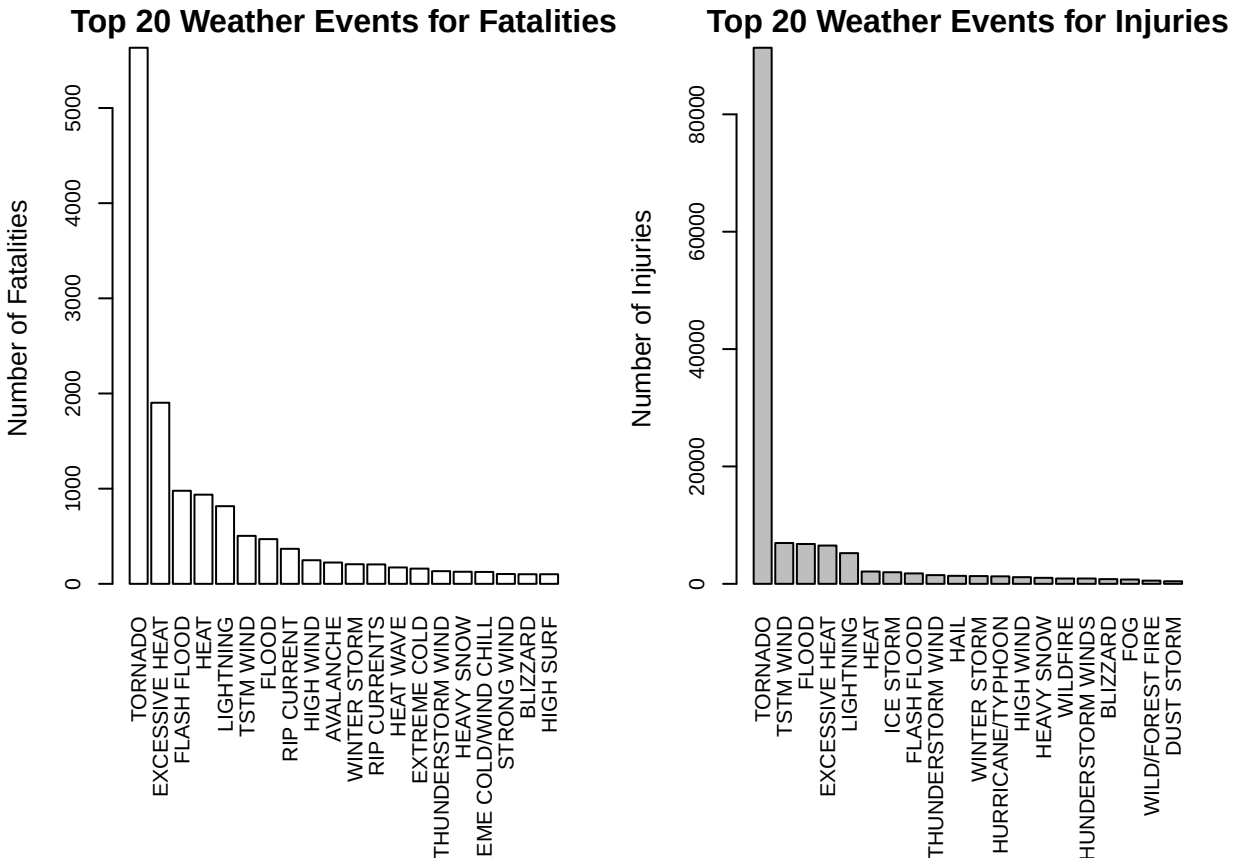
```
#The injuries
totalInjuries <- aggregate(data$INJURIES, by = list(data$EVTYPE), "sum")
names(totalInjuries) <- c("Event", "Injuries")
totalInjuriesSorted <- totalInjuries[order(-totalInjuries$Injuries), ][1:20, ]
totalInjuriesSorted
```

```
##                  Event Injuries
```

```
## 834            TORNADO    91346
## 856          TSTM WIND     6957
## 170              FLOOD     6789
## 130     EXCESSIVE HEAT     6525
## 464          LIGHTNING     5230
## 275               HEAT     2100
## 427          ICE STORM     1975
## 153        FLASH FLOOD     1777
## 760  THUNDERSTORM WIND     1488
## 244               HAIL     1361
## 972       WINTER STORM     1321
## 411  HURRICANE/TYPHOON     1275
## 359          HIGH WIND     1137
## 310         HEAVY SNOW     1021
## 957           WILDFIRE      911
## 786 THUNDERSTORM WINDS      908
## 30            BLIZZARD      805
## 188                 FOG      734
## 955   WILD/FOREST FIRE      545
## 117         DUST STORM      440
```

Compareing between fatalities and injuries by ploting:

```
par(mfrow = c(1, 2), mar = c(10, 4, 2, 2), las = 3, cex = 0.7, cex.main = 1.4, cex.lab = 1.2)
barplot(totalFatalitiesSorted$Fatalities, names.arg = totalFatalitiesSorted$Event, col = 'white',main =
barplot(totalInjuriesSorted$Injuries, names.arg = totalInjuriesSorted$Event, col = 'gray',main = 'Top 2
```



Calculate the cost of property and crop damages:

```
# property
totProperty <- aggregate(data$PROPDMG, by = list(data$EVTYPE), "sum")
names(totProperty) <- c("Event", "Property")
totPropertySorted <- totProperty[order(-totProperty$Property), ][1:20, ]
totPropertySorted
```

```
##                    Event   Property
## 834              TORNADO 3212258.16
## 153          FLASH FLOOD 1420124.59
## 856            TSTM WIND 1335965.61
## 170                FLOOD  899938.48
## 760    THUNDERSTORM WIND  876844.17
## 244                 HAIL  688693.38
## 464            LIGHTNING  603351.78
## 786   THUNDERSTORM WINDS  446293.18
## 359            HIGH WIND  324731.56
## 972         WINTER STORM  132720.59
## 310           HEAVY SNOW  122251.99
## 957              WILDFIRE   84459.34
## 427             ICE STORM   66000.67
## 676          STRONG WIND   62993.81
## 376           HIGH WINDS   55625.00
```

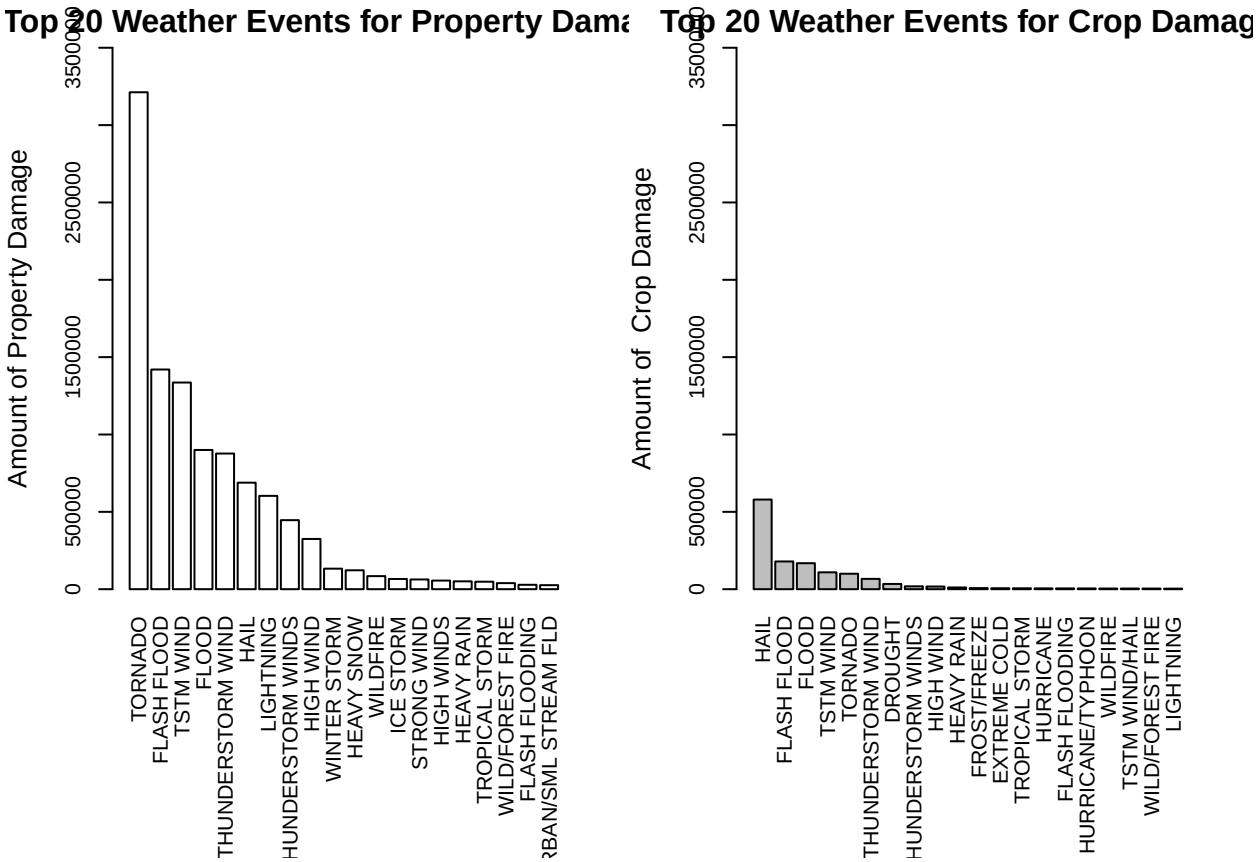
```
## 290           HEAVY RAIN   50842.14
## 848       TROPICAL STORM   48423.68
## 955     WILD/FOREST FIRE   39344.95
## 164       FLASH FLOODING   28497.15
## 919 URBAN/SML STREAM FLD   26051.94
```

```
# crop damages
totCrop <- aggregate(data$CROPDMG, by = list(data$EVTYPE), "sum")
names(totCrop) <- c("Event", "Crop")
totCropSorted <- totCrop[order(-totCrop$Crop), ][1:20, ]
totCropSorted
```

```
##                   Event      Crop
## 244                HAIL 579596.28
## 153         FLASH FLOOD 179200.46
## 170               FLOOD 168037.88
## 856           TSTM WIND 109202.60
## 834             TORNADO 100018.52
## 760  THUNDERSTORM WIND  66791.45
## 95              DROUGHT  33898.62
## 786 THUNDERSTORM WINDS  18684.93
## 359           HIGH WIND  17283.21
## 290          HEAVY RAIN  11122.80
## 212        FROST/FREEZE   7034.14
## 140        EXTREME COLD   6121.14
## 848      TROPICAL STORM   5899.12
## 402           HURRICANE   5339.31
## 164      FLASH FLOODING   5126.05
## 411  HURRICANE/TYPHOON   4798.48
## 957            WILDFIRE   4364.20
## 873      TSTM WIND/HAIL   4356.65
## 955   WILD/FOREST FIRE   4189.54
## 464           LIGHTNING   3580.61
```

Compareing between property and crop damages by ploting:

```
par(mfrow = c(1, 2), mar = c(10, 4, 2, 2), las = 3, cex = 0.7, cex.main = 1.4, cex.lab = 1.2)
barplot(totPropertySorted$Property, names.arg = totPropertySorted$Event, col = 'white',pch=19
,main = 'Top 20 Weather Events for Property Damage ', ylab = 'Amount of Property Damage', ylim = c(0, 35
barplot(totCropSorted$Crop, names.arg = totCropSorted$Event, col = 'gray', pch=19,
main = 'Top 20 Weather Events for Crop Damage', ylab = 'Amount of  Crop Damage',ylim = c(0, 3500000))
```



The total damage by adding costs:

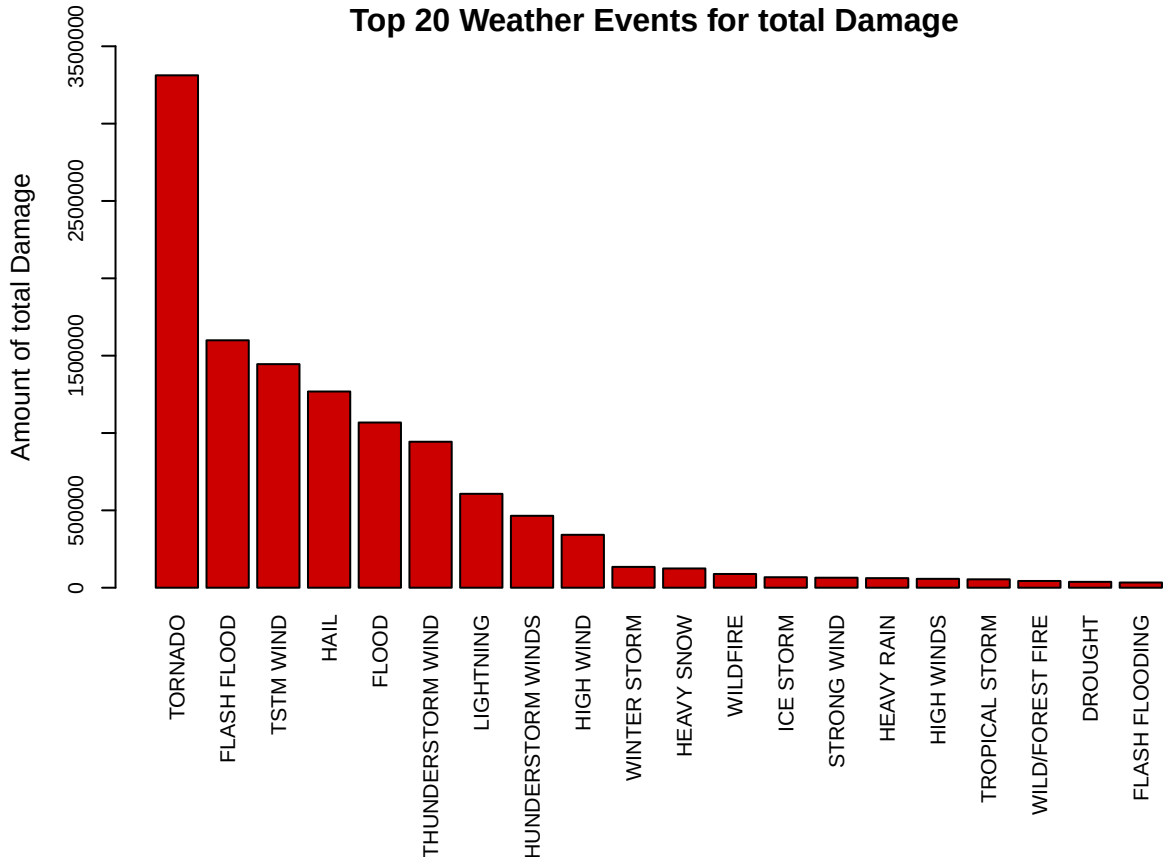
```
totTotalCost <- aggregate(data$CROPDMG+data$PROPDMG, by = list(data$EVTYPE), "sum")
names(totTotalCost) <- c("Event", "TotalCost")
totTotalCostSorted <- totTotalCost[order(-totTotalCost$TotalCost), ][1:20, ]
totTotalCostSorted
```

```
##                  Event  TotalCost
## 834            TORNADO 3312276.68
## 153        FLASH FLOOD 1599325.05
## 856          TSTM WIND 1445168.21
## 244               HAIL 1268289.66
## 170              FLOOD 1067976.36
## 760  THUNDERSTORM WIND  943635.62
## 464          LIGHTNING  606932.39
## 786 THUNDERSTORM WINDS  464978.11
## 359          HIGH WIND  342014.77
## 972       WINTER STORM  134699.58
## 310         HEAVY SNOW  124417.71
## 957           WILDFIRE   88823.54
## 427          ICE STORM   67689.62
## 676        STRONG WIND   64610.71
## 290         HEAVY RAIN   61964.94
## 376         HIGH WINDS   57384.60
```

```
## 848     TROPICAL STORM   54322.80
## 955   WILD/FOREST FIRE   43534.49
## 95              DROUGHT   37997.67
## 164     FLASH FLOODING   33623.20
```

plot of total damage after adding costs:

```
par(mfrow = c(1,1), mar = c(10, 4, 2, 2), las = 3, cex = 0.7, cex.main = 1.4, cex.lab = 1.2)
barplot(totTotalCostSorted$TotalCost, names.arg = totTotalCostSorted$Event, col = 'red3',main = 'Top 20
```



The tornadoes cause most total damage.