Reproducible Research - Week 4 Peer Project

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Synopsis

Storms and other severe weather events can cause both public health and economic problems for communities and municipalities. Many severe events can result in fatalities, injuries, and property damage, and preventing such outcomes to the extent possible is a key concern.

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.

Assignment

The basic goal of this assignment is to explore the NOAA Storm Database and answer some basic questions about severe weather events. You must use the database to answer the questions below and show the code for your entire analysis. Your analysis can consist of tables, figures, or other summaries. You may use any R package you want to support your analysis.

Data

The data for this assignment come in the form of a comma-separated-value file compressed via the bzip2 algorithm to reduce its size. You can download the file from the course web site:

Storm Data

There is also some documentation of the database available. Here you will find how some of the variables are constructed/defined.

- National Weather Service Storm Data Documentation
- National Climatic Data Center Storm Events FAQ

The events in the database start in the year 1950 and end in November 2011. In the earlier years of the database there are generally fewer events recorded, most likely due to a lack of good records. More recent years should be considered more complete.

Data Pre-processing

The Storm Data is fetched, downloaded to the local system and then its contents are read based on the code given below

```
# This section deals with the downloading the compressed file and
# extracting it contents.

stormData <- "https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"

# The file is downloaded using the download.file function.
download.file(stormData, destfile = "../StormData.csv.bz2")
```

```r
# reading data from the file
readStormData <- read.csv("../StormData.csv.bz2")

# Fetching column names of Storm Data using the colNames function
colnames(readStormData)
```

```
##  [1] "STATE__"    "BGN_DATE"   "BGN_TIME"   "TIME_ZONE"  "COUNTY"
##  [6] "COUNTYNAME" "STATE"      "EVTYPE"     "BGN_RANGE"  "BGN_AZI"
## [11] "BGN_LOCATI" "END_DATE"   "END_TIME"   "COUNTY_END" "COUNTYENDN"
## [16] "END_RANGE"  "END_AZI"    "END_LOCATI" "LENGTH"     "WIDTH"
## [21] "F"          "MAG"        "FATALITIES" "INJURIES"   "PROPDMG"
## [26] "PROPDMGEXP" "CROPDMG"    "CROPDMGEXP" "WFO"        "STATEOFFIC"
## [31] "ZONENAMES"  "LATITUDE"   "LONGITUDE"  "LATITUDE_E" "LONGITUDE_"
## [36] "REMARKS"    "REFNUM"
```

```r
str(readStormData)
```

```
## '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 ...
```

```
# Fetching first few rows of Storm Data
head(readStormData)
```

```
##   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
```

```
# fetching the unique event type in the Storm Data
head(unique(readStormData$EVTYPE))
```

```
## [1] "TORNADO"               "TSTM WIND"             "HAIL"
## [4] "FREEZING RAIN"         "SNOW"                  "ICE STORM/FLASH FLOOD"
```

We notice that the Date format is that of a Character from the below code

```
class(readStormData$BGN_DATE)
```

```
## [1] "character"
```

We will convert it to Date format using the as.Date function and assign it to a new variable stormDate

```
readStormData$BGN_DATE <- as.Date(readStormData$BGN_DATE, format = "%m%d%Y %H:%m:%s")
class(readStormData$BGN_DATE)
```

```
## [1] "Date"
```

Getting the events type as a Data Frame

```
# subsetting the Storm Data
readStormData <- subset(readStormData,
                        select = c(EVTYPE, FATALITIES,
                          INJURIES, PROPDMG, PROPDMGEXP, CROPDMG,
                          CROPDMGEXP))

unique(readStormData$PROPDMGEXP)
```

```
##  [1] "K" "M" ""  "B" "m" "+" "0" "5" "6" "?" "4" "2" "3" "h" "7" "H" "-" "1" "8"
```

1. Across the United States, which types of events (as indicated in the EVTYPE variable) are most harmful with respect to population health? Since we have already subset the original data based on the EVTYPE, FATALITIES, INJURIES, PROPDMG, PROPDMGEXP, CROPDMG and CROPDMGEXP we now need to process the data further in such a way that for each "EVTYPE" we need to find the FATALTIES and INJURIES.

Doing the above process would give us an insight as to which event type caused maximum fatalities and injuries.

```
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
```

```
# Aggregating and arranging the Fatalities and Injuries

stormDataFatalities <- arrange(
  aggregate(FATALITIES ~ EVTYPE, data = readStormData, sum),
  desc(FATALITIES), EVTYPE)[1:10,]

# Aggregated data of the Storm Fatalities based on the event type
stormDataFatalities
```

```
##            EVTYPE FATALITIES
## 1         TORNADO       5633
## 2  EXCESSIVE HEAT       1903
## 3     FLASH FLOOD        978
## 4            HEAT        937
## 5       LIGHTNING        816
## 6       TSTM WIND        504
## 7           FLOOD        470
## 8     RIP CURRENT        368
## 9       HIGH WIND        248
## 10      AVALANCHE        224
```

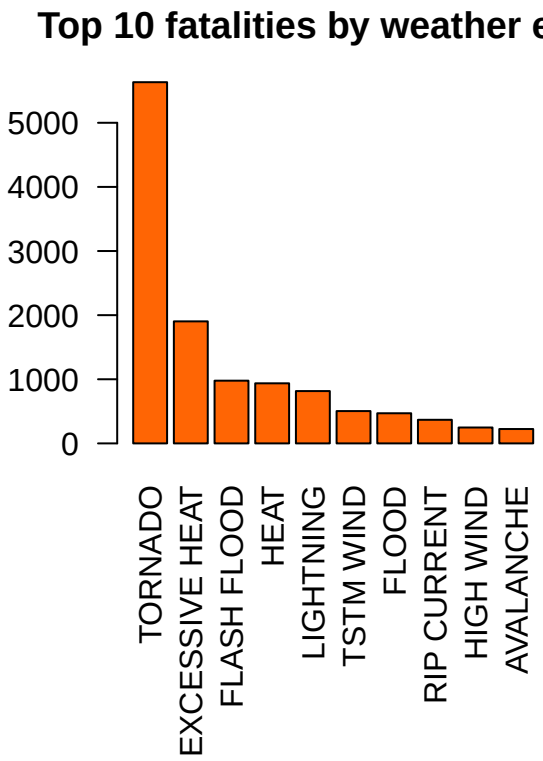
```
stormDataInjuries <- arrange(
  aggregate(INJURIES ~ EVTYPE, data = readStormData, sum),
```

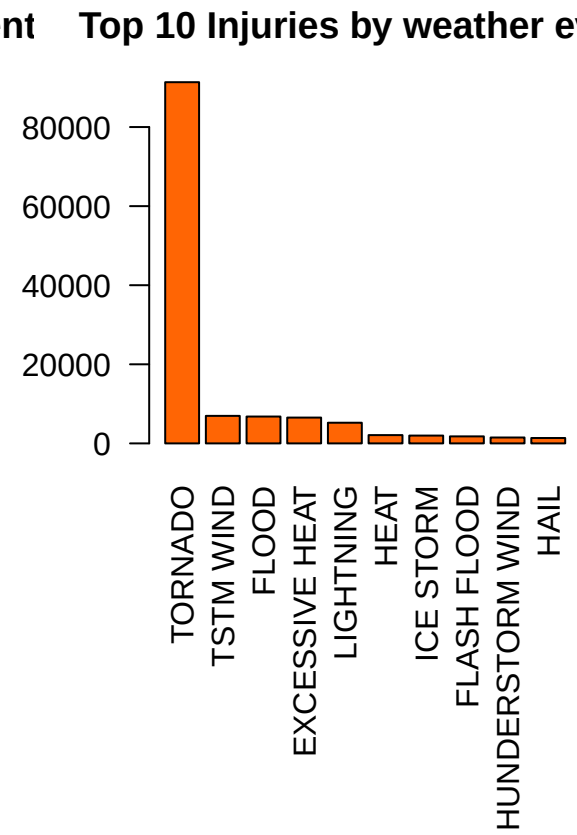
```
  desc(INJURIES), EVTYPE)[1:10,]

# Aggregated data of the Storm Injuries based on the event type
stormDataInjuries
```

```
##               EVTYPE INJURIES
## 1            TORNADO    91346
## 2          TSTM WIND     6957
## 3              FLOOD     6789
## 4     EXCESSIVE HEAT     6525
## 5          LIGHTNING     5230
## 6               HEAT     2100
## 7          ICE STORM     1975
## 8        FLASH FLOOD     1777
## 9  THUNDERSTORM WIND     1488
## 10             HAIL     1361
```

From both the "stormDataFatalities" and "stormDataInjuries" we can see that event type "TORNADO" has registered the highest number of Fatalities and Injuries, now let is plot the same on the graph.

```
library(lattice)
# plotting the graphs for the Fatalities and Injuries

par(mfrow=c(1,2),mar=c(10,3,3,2))

# Fatalities by event type

barplot(stormDataFatalities$FATALITIES,
        names.arg=stormDataFatalities$EVTYPE,
        las=2,
        col="#FF6504",
        ylab="Fatalities",
        main="Top 10 fatalities by weather event")

# Injuries by event type
barplot(stormDataInjuries$INJURIES,
        names.arg=stormDataInjuries$EVTYPE,
        las=2,
        col="#FF6504",
        ylab="Injuries",
        main="Top 10 Injuries by weather event")
```


Top 10 fatalities by weather event
5000
4000
3000
2000
1000
0
TORNADO
EXCESSIVE HEAT
FLASH FLOOD
HEAT
LIGHTNING
TSTM WIND
FLOOD
RIP CURRENT
HIGH WIND
AVALANCHE


Top 10 Injuries by weather event
80000
60000
40000
20000
0
TORNADO
TSTM WIND
FLOOD
EXCESSIVE HEAT
LIGHTNING
HEAT
ICE STORM
FLASH FLOOD
HUNDERSTORM WIND
HAIL