Most dangerous storm events for population and economy.

Synopsis

In this report we will investigate the dataset Storm Data from NATIONAL WEATHER SERVICE.
The goal of our analysis is to find out what type of events in Storm Data are most harmful for people and for economy. Folowing this goal we will examine two questions:

1. Which types of events are most harmful with respect to population health?
2. Which types of events have the greatest economic consequences?

Analysis will show to us that tornado is most dangerous “event” for people without any doubt.
For economy we will see two different events for two different sides of economy. Flood is most harmful for property, while the drought has critical consequences for crop.

Data Processing

Loading Data

Our first step is download Storm Data from the Internet.
After that we will load dataset in several steps.

- We read one row and define what features (columns) we need for our analysis.
- Load only this limited set of features. It's will save us computer memory and time.
- Our dataset is compressed bz2 file. We will use “bzfile” function from base package to read our data directly from the archive.

```
# download data if not downloaded already
fn <- "data/repdata-data-StormData.csv.bz2"
if (!file.exists(fn)) {
    message("Downloading dataset.")

download.file("https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2",

        destfile = fn)
}

# read one row
fnbz <- bzfile(fn, "r")
data <- read.csv(fnbz, header = TRUE, nrows = 1)
close(fnbz)
```

We know from National Weather Service Storm Data Documentation we need only several features from dataset. They are:

- EVTYPE - Event type
- FATALITIES - Event-related fatalities
- INJURIES - Event-related injuries
- PROPDMG - Property damage amount
- PROPDMGEXP - Property damage units
- CROPDMG - Crop damage amount
- CROPDMGEXP - Crop damage units

where “damage units” are “K” for thousands, “M” for millions, and “B” for billions.

```
allNames <- names(data)

# limited features for analysis. names and indexes
featureNames <- c("EVTYPE", "FATALITIES", "INJURIES", "PROPDMG", "PROPDMGEXP",
    "CROPDMG", "CROPDMGEXP")
featureInd <- sapply(featureNames, function(x) {
    which(allNames == x)
})

dcols <- rep("NULL", ncol(data))
dcols[featureInd] <- NA

# read limited set of features
fnbz <- bzfile(fn, "r")
data <- read.csv(fnbz, header = T, colClasses = dcols)
close(fnbz)
```

Clearing Data

At this point of analysis we have our data loaded. The only thing we need is to clearing our data.
We will:

- Convert events to uppercase.
- Transform Property damage units and Crop damage units into numeric multipliers. Our converting policy is simple. If damage unit is one of the “K”(“k”), “M”(“m”), “B”(“b”) we will convert it to 1e+3, 1e+6, 1e+9 accordingly, otherwise we return zero

```
# convert function. use with sapply
dnum <- data.frame(K = 1000, M = 1e+06, B = 1e+09)
fnum <- function(x) {
    if (x %in% c("K", "M", "B"))
        dnum[1, x] else 0
}

data <- transform(data, EVTYPE = as.factor(toupper(EVTYPE)))
data <- transform(data, PROPDMGEXP = toupper(PROPDMGEXP), CROPDMGEXP =
toupper(CROPDMGEXP))
data <- transform(data, PROPDMGEXP = sapply(PROPDMGEXP, fnum), CROPDMGEXP =
sapply(CROPDMGEXP,
    fnum))
```

The final step is to make some preparation to find answers to our questions quickly.

First, we will need to measure storm events impact to population. We define two cross tables for this purpose. One for FATALITIES, one for INJURIES.

```
tabF <- sort(xtabs(FATALITIES ~ EVTYPE, data = data), decreasing = T)
tabI <- sort(xtabs(INJURIES ~ EVTYPE, data = data), decreasing = T)
```

The same way we define cross tables to measure events impact to economy. The only difference, we will need additionally multiply columns PROPDMG and PROPDMGEXP for property losses and CROPDMG and CROPDMGEXP for crop losses.

```
tabP <- data.frame(EVTYPE = data$EVTYPE, PROPDMG = data$PROPDMG * data$PROPDMGEXP)
tabC <- data.frame(EVTYPE = data$EVTYPE, CROPDMG = data$CROPDMG * data$CROPDMGEXP)
tabP <- sort(xtabs(PROPDMG ~ EVTYPE, data = tabP), decreasing = T)
tabC <- sort(xtabs(CROPDMG ~ EVTYPE, data = tabC), decreasing = T)
```

At this point of analysis we ready to present results.

Results

Most harmful events for Population.

Our first question was about types of events which are most harmful with respect to population health.

The most influential ten events for FATALITIES are:

```
data.frame(TYPE_EVENT = names(tabF[1:10]), Fatalities = tabF[1:10], row.names =
1:10)
```

```
##         TYPE_EVENT 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
```

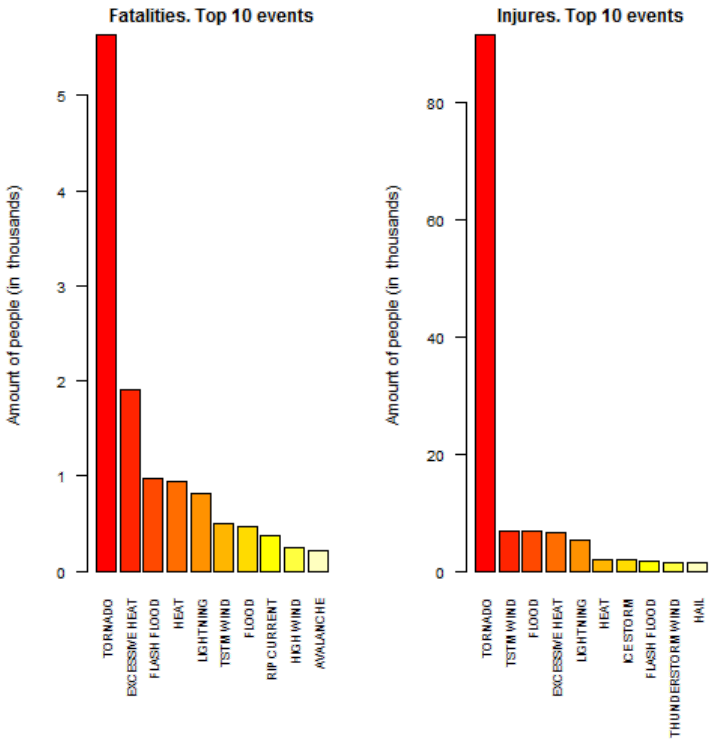
The most influential ten events for INJURIES are:

```
data.frame(TYPE_EVENT = names(tabI[1:10]), Injuries = tabI[1:10], row.names = 1:10)
```

```
##           TYPE_EVENT 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
```

We can illustrate this results in graphic:

```
par(mfrow = c(1, 2))
par(mar = c(8, 4, 2, 2))
barplot(tabF[1:10]/1000, col = heat.colors(10, alpha = 1), las = 2, cex.names =
0.7,
    cex.main = 1, cex.lab = 0.9, cex.axis = 0.8, ylab = "Amount of people (in
thousands)",
    main = "Fatalities. Top 10 events")
barplot(tabI[1:10]/1000, col = heat.colors(10, alpha = 1), las = 2, cex.names =
0.7,
    cex.main = 1, cex.lab = 0.9, cex.axis = 0.8, ylab = "Amount of people (in
thousands)",
    main = "Injures. Top 10 events")
```



Most dangerous events for Economy.

Our second question was about types of events are most harmful for economy.

The most influential ten events for Property damage are:

```
data.frame(TYPE_EVENT = names(tabP[1:10]), Property_damage = tabP[1:10], row.names
= 1:10)
```

```
##            TYPE_EVENT Property_damage
## 1               FLOOD       1.447e+11
## 2   HURRICANE/TYPHOON       6.931e+10
## 3             TORNADO       5.694e+10
## 4         STORM SURGE       4.332e+10
## 5         FLASH FLOOD       1.614e+10
## 6                HAIL       1.573e+10
## 7           HURRICANE       1.187e+10
## 8      TROPICAL STORM       7.704e+09
## 9        WINTER STORM       6.688e+09
## 10          HIGH WIND       5.270e+09
```

The most influential ten events for Crop damage are:

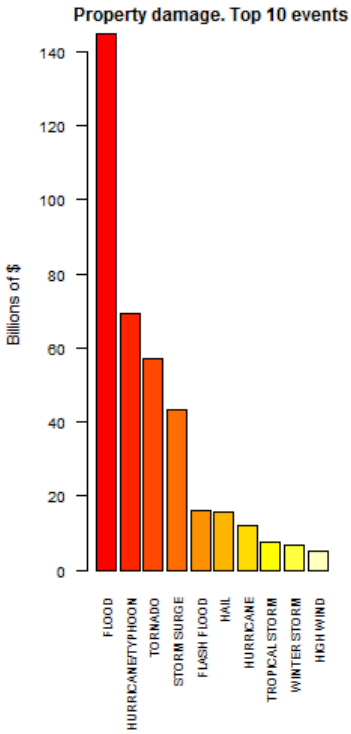
```
data.frame(TYPE_EVENT = names(tabC[1:10]), Crop_damage = tabC[1:10], row.names =
1:10)
```

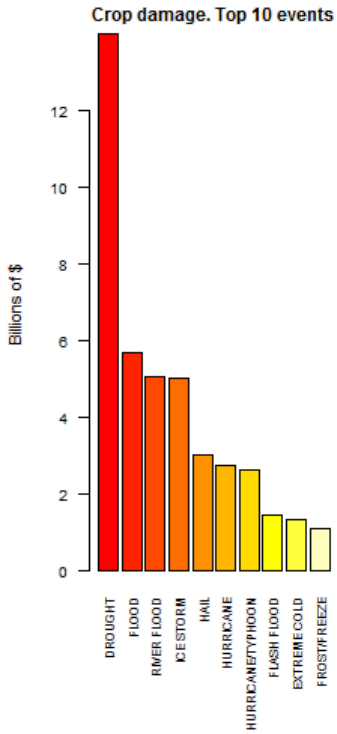
```
##            TYPE_EVENT Crop_damage
## 1             DROUGHT   1.397e+10
## 2               FLOOD   5.662e+09
## 3         RIVER FLOOD   5.029e+09
## 4           ICE STORM   5.022e+09
## 5                HAIL   3.026e+09
## 6           HURRICANE   2.742e+09
## 7   HURRICANE/TYPHOON   2.608e+09
## 8         FLASH FLOOD   1.421e+09
## 9        EXTREME COLD   1.313e+09
## 10       FROST/FREEZE   1.094e+09
```

We can illustrate this results in graphic:

```
par(mfrow = c(1, 2))
par(mar = c(8, 4, 2, 2))
barplot(tabP[1:10]/1e+09, col = heat.colors(10, alpha = 1), las = 2, cex.names =
0.7,
    cex.main = 1, cex.lab = 0.9, cex.axis = 0.8, ylab = "Billions of $", main =
"Property damage. Top 10 events")

barplot(tabC[1:10]/1e+09, col = heat.colors(10, alpha = 1), las = 2, cex.names =
0.7,
    cex.main = 1, cex.lab = 0.9, cex.axis = 0.8, ylab = "Billions of $", main =
"Crop damage. Top 10 events")
```





Conclusion

The most harmful events for Population and for economy are differ.
For people tornado is most dangerous event with huge advantage over other events.
For economy it's a little bit “complicated”. We have difernt most harmful events for property and for crop which are the most harmful. Floods make the lagest damage for
property while drough are most dangerous for crop.