The most severe weather events across the US from 1950 to 2011

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30 de julio de 2017

Course Project 2

The most severe weather events across the US from 1950 to 2011

Important: If you want to run the entire code, just get rid of all the '#' symbols whenever you see an R chunk.

Synopsis: Severe weather events can cause both public health (fatalities, injuries) and economic problems (property damage) for communities, and preventing such outcomes is a key concern; this project involves exploring the U.S. National Oceanic and Atmospheric Administration's (NOAA) storm database wich 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, the events in the database start in the year 1950 and end in November 2011.

The goal of the proyect is to answer two questions; across the United States:

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

Set working directory

```
setwd("C:/Users/FernandoBarranco/Desktop")
```

Data Processing

Download the data from the following url (if necessary)

```
url <- "https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"
# download.file(url, "C:/Users/FernandoBarranco/Desktop/StormData.csv.bz2")
```

Unzip the .csv file

```
# install.packages("R.utils")
# library(R.utils)
# bunzip2("StormData.csv.bz2", "StormData.csv", remove = FALSE, skip = TRUE)
```

Read the data into R

```
# install.packages("data.table")
library(data.table)
storm_data <- fread("StormData.csv")
```

```
##
Read 0.0% of 967216 rows
Read 25.8% of 967216 rows
Read 42.4% of 967216 rows
Read 60.0% of 967216 rows
```

```
Read 74.4% of 967216 rows
Read 80.6% of 967216 rows
Read 92.0% of 967216 rows
Read 902297 rows and 37 (of 37) columns from 0.523 GB file in 00:00:09
```

Subset, transform and clean the data

Rename variables

```r
# install.packages("dplyr")
library(dplyr)
# install.packages("lubridate")
library(lubridate)
variables <- names(storm_data)
names(storm_data) <- tolower(variables)
```

Keep variables to analyze

```r
storm_data_sub <- storm_data %>% select(bgn_date, state, evtype, fatalities,
                      injuries, propdmg, propdmgexp, cropdmg, cropdmgexp)
```

Change to date format

```r
storm_data_sub$bgn_date <- as.Date(storm_data_sub$bgn_date, format = "%m/%d/%Y %H:%M:%S")
```

Removing observations with no fatalities nor injuries

```r
storm_data_sub <- storm_data_sub %>%
        mutate(year = year(bgn_date), evtype = tolower(evtype)) %>%
        select(-bgn_date, state, evtype, fatalities, injuries, year) %>%
        filter(fatalities != 0 | injuries != 0)
head(storm_data_sub)
```

```
##   state  evtype fatalities injuries propdmg propdmgexp cropdmg cropdmgexp year
## 1    AL tornado          0       15    25.0          K       0            1950
## 2    AL tornado          0        2    25.0          K       0            1951
## 3    AL tornado          0        2     2.5          K       0            1951
## 4    AL tornado          0        2     2.5          K       0            1951
## 5    AL tornado          0        6     2.5          K       0            1951
## 6    AL tornado          0        1     2.5          K       0            1951
```

Data wrangling and feature engineering

Sum up fatalities and injuries by event type

```r
fatalities <- aggregate(fatalities ~ evtype, storm_data_sub, sum)
head(fatalities)
```

```
##         evtype fatalities
## 1     avalance          1
## 2    avalanche        224
## 3    black ice          1
## 4     blizzard        101
## 5 blowing snow          2
## 6   brush fire          0
```

```r
injuries <- aggregate(injuries ~ evtype, storm_data_sub, sum)
head(injuries)
```

```
##          evtype injuries
## 1      avalance        0
## 2     avalanche      170
## 3     black ice       24
## 4      blizzard      805
## 5 blowing snow       14
## 6    brush fire        2
```

Keep extreme values that causes the highest damages

```r
storm_data_health <- inner_join(fatalities, injuries, by = "evtype") %>%
        filter(fatalities > quantile(fatalities, probs = .97) &
                injuries > quantile(injuries, probs = .97))
storm_data_health
```

```
##           evtype fatalities injuries
## 1 excessive heat       1903     6525
## 2          flood        470     6789
## 3           heat        937     2100
## 4      lightning        816     5230
## 5        tornado       5633    91346
## 6      tstm wind        504     6957
```

Note: The 'storm_data_health' dataset will help us answer question 1

Property damages counts

```r
table(storm_data_sub$propdmgexp)
```

```
##
##            -     0     5     7     B     H     K     m     M
##  7248      1     5     1     1    19     1 11155     1  3497
```

```r
table(storm_data_sub$cropdmgexp)
```

```
##
##            0     B     K     M
## 17490      1     1  4253   184
```

Map property damage alphanumeric exponents to numeric values.

```r
propdmgkey_level <- c("-", "0", "5", "7", "H", "K", "M", "B")
propdmgkey_label <- c( 10^0+1 , 10^0, 10^5, 10^7, 10^2, 10^3, 10^6, 10^9 )
```

Map crop damage alphanumeric exponents to numeric values

```r
cropdmgkey_level <- c("0", "K", "M", "B")
cropdmgkey_label <- c( 10^0, 10^3, 10^6, 10^9 )
```

Create new variables that contain the total property damage

```r
storm_data_eco <- storm_data_sub %>%
        select(-(c(state, fatalities, injuries, year))) %>%
        mutate(propdmgexp = toupper(propdmgexp),
               cropdmgkey = factor(cropdmgexp, cropdmgkey_level, cropdmgkey_label),
               propdmgkey = factor(propdmgexp, propdmgkey_level, propdmgkey_label),
               cropdmgkey = as.numeric(as.character(cropdmgkey)),
```

```r
                propdmgkey = as.numeric(as.character(propdmgkey)),
                propdmgtot = propdmg * propdmgkey,
                cropdmgtot = cropdmg * cropdmgkey )
head(storm_data_eco)
```

```
##    evtype propdmg propdmgexp cropdmg cropdmgexp cropdmgkey propdmgkey propdmgtot cropdmgtot
## 1 tornado    25.0          K       0                    NA       1000      25000         NA
## 2 tornado    25.0          K       0                    NA       1000      25000         NA
## 3 tornado     2.5          K       0                    NA       1000       2500         NA
## 4 tornado     2.5          K       0                    NA       1000       2500         NA
## 5 tornado     2.5          K       0                    NA       1000       2500         NA
## 6 tornado     2.5          K       0                    NA       1000       2500         NA
```

Sum up property damage by event type

```r
propdmgtotal <- aggregate(propdmgtot ~ evtype, storm_data_eco, sum)
head(propdmgtotal)
```

```
##                     evtype propdmgtot
## 1                avalanche     728800
## 2                 blizzard  526756000
## 3              blowing snow      15000
## 4             coastal flood    1000000
## 5          coastal flooding      35000
## 6 coastal flooding/erosion    1700000
```

```r
cropdmgtotal <- aggregate(cropdmgtot ~ evtype, storm_data_eco, sum)
head(cropdmgtotal)
```

```
##            evtype cropdmgtot
## 1       avalanche          0
## 2        blizzard  112050000
## 3   coastal flood          0
## 4 cold/wind chill          0
## 5       dense fog          0
## 6         drought    2000000
```

Keep extreme values that causes the highest damages

```r
storm_data_economy <- full_join(propdmgtotal, cropdmgtotal, by = "evtype") %>%
        filter( propdmgtot > quantile(propdmgtot, probs = .90, na.rm = T) &
                cropdmgtot > quantile(cropdmgtot, probs = .90, na.rm = T))
storm_data_economy
```

```
##              evtype  propdmgtot cropdmgtot
## 1              hail  3505785701  166300000
## 2         high wind  2818983110  351980100
## 3         hurricane  2812660000 1406720000
## 4 hurricane/typhoon 32747770000 2273120800
## 5    tropical storm  6560156000  157265000
## 6          wildfire  3484359200  182087000
```

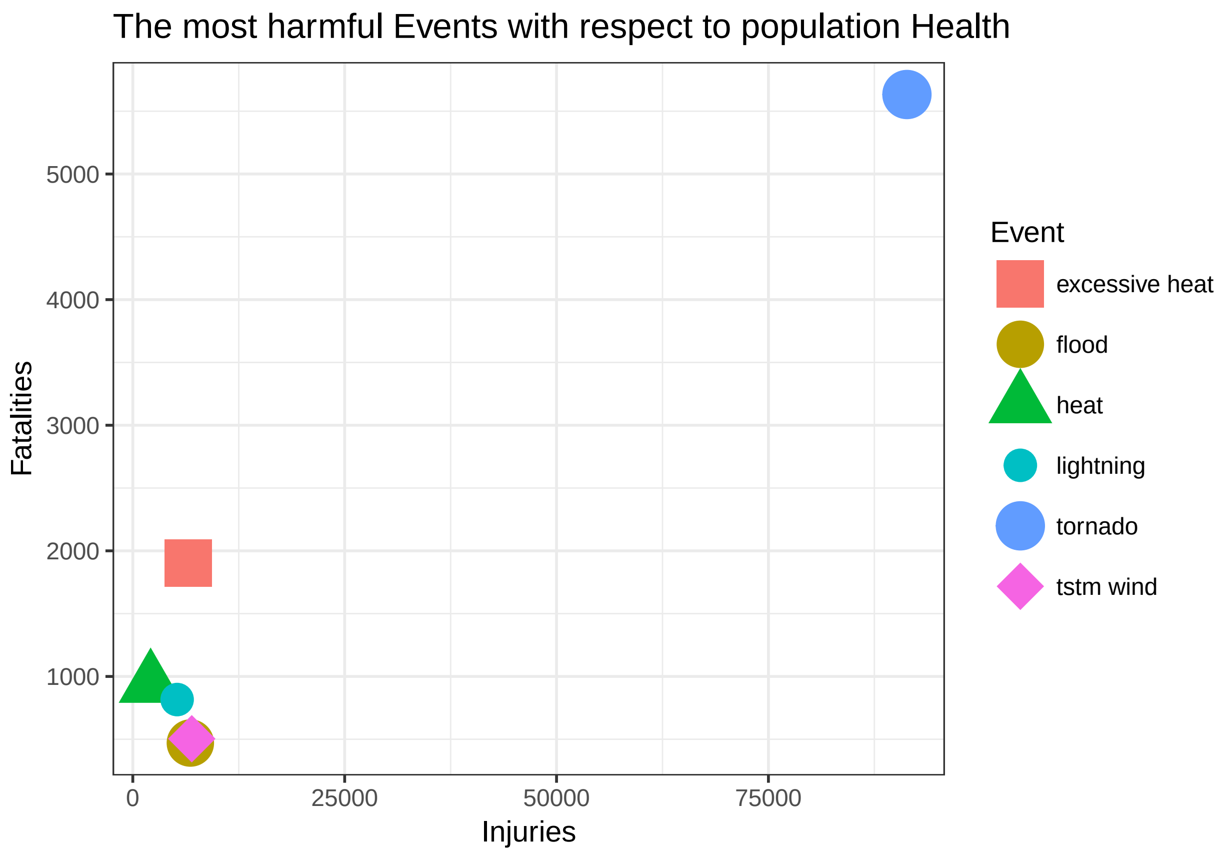
Note: The 'storm_data_economy' dataset will help us answer question 2

Results

```
# install.packages("ggplot2")
library(ggplot2)
```

- Which types of events are most harmful with respect to population health?

```
ggplot(storm_data_health, aes(injuries, fatalities, color = evtype, shape = evtype)) +
        geom_point(size = 8, alpha = 1) +
        guides(color = guide_legend("Event")) +
        theme_set(theme_bw()) +
        labs(x = "Injuries", y = "Fatalities",
             title = "The most harmful Events with respect to population Health") +
        scale_shape_manual(name = "Event",
                           values = c(15, 16, 17, 20, 19, 18))
```

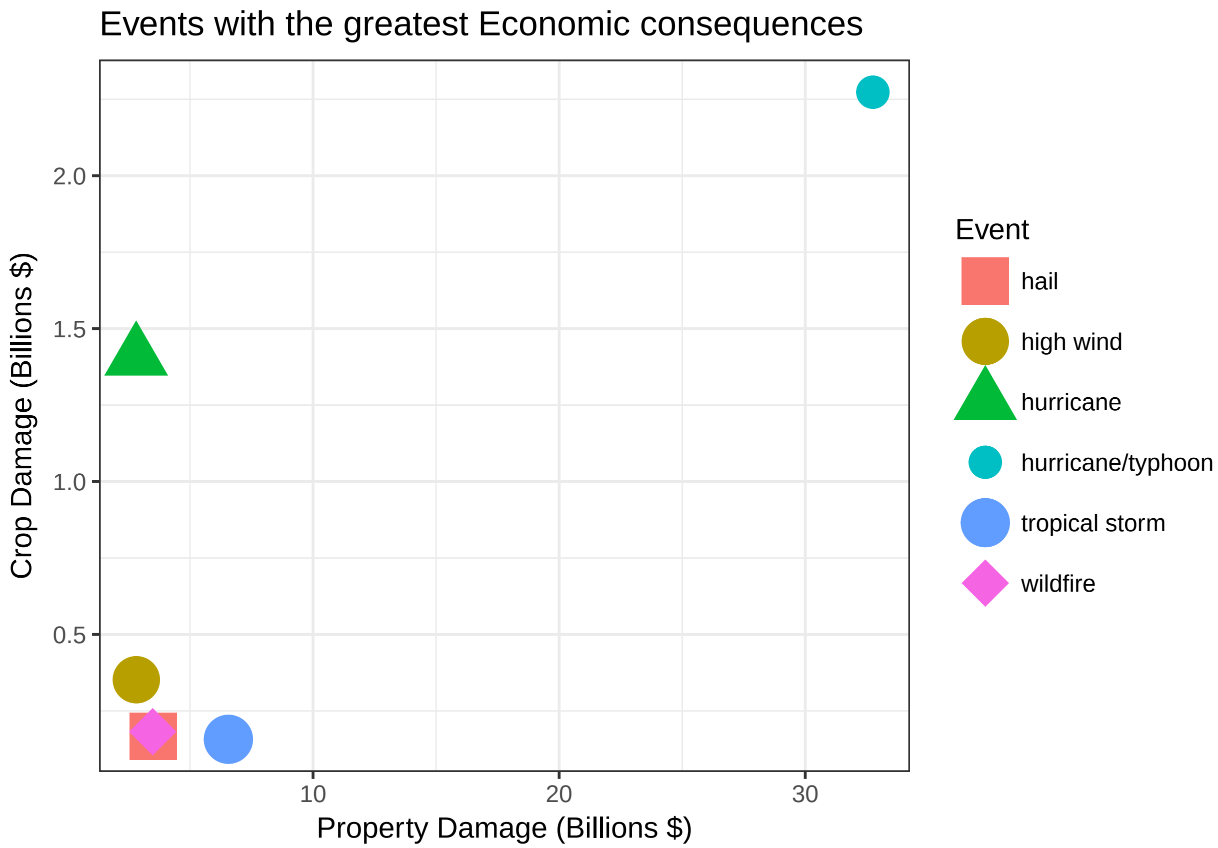


Notice that tornado has the highest values for both injuries and fatalities, this event is the most harmful to population health.

- Which types of events have the greatest economic consequences?

```
ggplot(storm_data_economy, aes(propdmgtot/10^9, cropdmgtot/10^9, shape = evtype)) +
        geom_point(size = 8, alpha = 1, aes(color = evtype)) +
        guides(color = guide_legend("Event")) +
        theme_set(theme_bw()) +
        labs(x = "Property Damage (Billions $)", y = "Crop Damage (Billions $)",
             title = "Events with the greatest Economic consequences") +
        scale_shape_manual(name = "Event",
```

```
values = c(15, 16, 17, 20, 19, 18))
```



Notice that hurricane/typhoon has the highest values for property damage, this event causes the greatest economic losses.