Health and Economic Impact of Storms in United States, 1950-2011

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Synopsis

The goal of the assignment is to explore the NOAA Storm Database (https://d396qusza40orc.cloudfront.net /repdata%2Fdata%2FStormData.csv.bz2) and investigate which types of severe weather events are most harmful on:

1. Population health (injuries and fatalities)
2. Economy (property and crop damages)

The events in the database start in the year 1950 and end in November 2011.

Data Processing

Load libraries.

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.2.5
```

```
##
## 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(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.2.5
```

Download and unzip the storm data file.

```
dataFile = "repdata%2Fdata%2FStormData.csv.bz2"
if (!file.exists(dataFile)){
        fileURL <- "https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"
        download.file(fileURL, zipFile, method="curl")
}
```

Load storm data (only relevant columns for the analysis).

```
storm <- read.csv(dataFile)[,c("EVTYPE", "FATALITIES", "INJURIES", "PROPDMG", "PROPDMGEXP", "CROPDMG", "CROPDMG
EXP")]
head(storm, 10)
```

```
##     EVTYPE FATALITIES INJURIES PROPDMG PROPDMGEXP CROPDMG CROPDMGEXP
## 1  TORNADO          0       15    25.0          K       0
## 2  TORNADO          0        0     2.5          K       0
## 3  TORNADO          0        2    25.0          K       0
## 4  TORNADO          0        2     2.5          K       0
## 5  TORNADO          0        2     2.5          K       0
## 6  TORNADO          0        6     2.5          K       0
## 7  TORNADO          0        1     2.5          K       0
## 8  TORNADO          0        0     2.5          K       0
## 9  TORNADO          1       14    25.0          K       0
## 10 TORNADO          0        0    25.0          K       0
```

Discard events with non casualties or property / cost damages:

```
storm <- storm %>% filter(INJURIES > 0 | FATALITIES > 0 | PROPDMG > 0 | CROPDMG > 0)
```

Add casualties column (sum of fatalities and injuries).

```
storm$casualties <- storm$FATALITIES + storm$INJURIES
```

Define function to convert property / crop damage exponents to numeric values for cost calculations.

```
exponentMap <- function(exponent) {
        if (exponent == "")
                return (10^0)
        map <- c("0" = 10^0, "1" = 10^1, "2" = 10^2, "3" = 10^3,
          "4" = 10^4, "5" = 10^5, "6" = 10^6, "7" = 10^7,
          "8" = 10^8, "9" = 10^9, "h" = 10^2, "k" = 10^3,
          "m" = 10^6, "b" = 10^9, "-" = 10^0, "?" = 10^0,
          "+" = 10^0)
        return (map[tolower(exponent)])
}
```

Add economic cost column (sum of property and crop costs).

```
storm$economicCost <- storm$PROPDMG * unlist(lapply(storm$PROPDMGEXP, exponentMap)) + storm$CROPDMG * unlist(la
pply(storm$CROPDMGEXP, exponentMap))
```

Group casualties by event type.

```
casualtiesByEvtype <- storm %>%
        group_by(EVTYPE) %>%
        summarise(casualties = sum(casualties))
head(casualtiesByEvtype, 10)
```

```
## # A tibble: 10 × 2
##                    EVTYPE casualties
##                    <fctr>      <dbl>
## 1      HIGH SURF ADVISORY          0
## 2             FLASH FLOOD          0
## 3               TSTM WIND          0
## 4         TSTM WIND (G45)          0
## 5                       ?          0
## 6     AGRICULTURAL FREEZE          0
## 7           APACHE COUNTY          0
## 8  ASTRONOMICAL HIGH TIDE          0
## 9   ASTRONOMICAL LOW TIDE          0
## 10               AVALANCE          1
```

Group economic cost by event type.

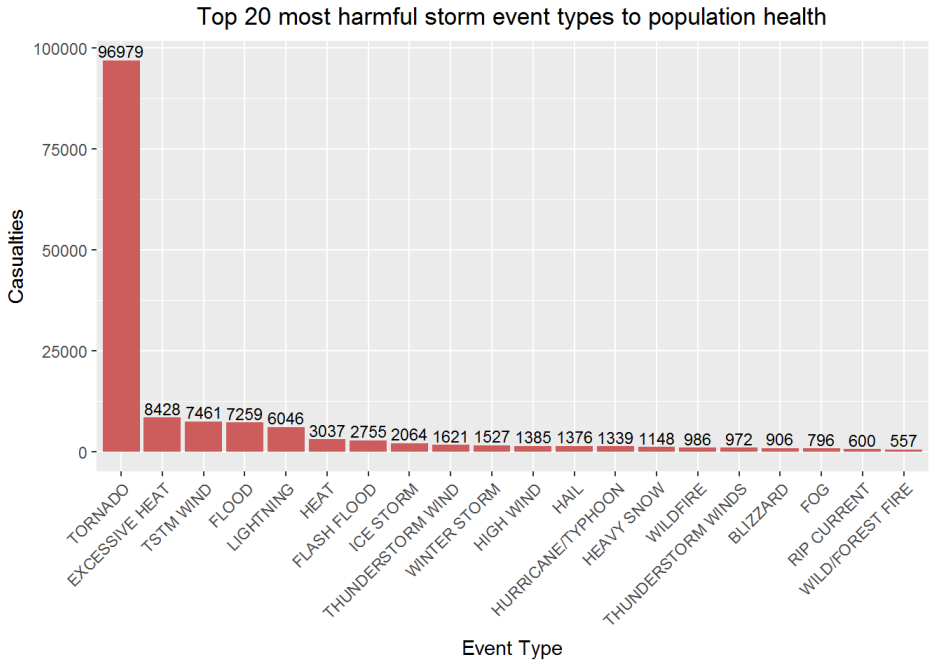
```
economicCostByEvtype <- storm %>%
        group_by(EVTYPE) %>%
        summarise(economicCost = sum(economicCost))
head(economicCostByEvtype, 10)
```

```
## # A tibble: 10 × 2
##                    EVTYPE economicCost
##                    <fctr>        <dbl>
## 1      HIGH SURF ADVISORY       200000
## 2             FLASH FLOOD        50000
## 3               TSTM WIND      8100000
## 4         TSTM WIND (G45)         8000
## 5                       ?         5000
## 6     AGRICULTURAL FREEZE     28820000
## 7           APACHE COUNTY         5000
## 8  ASTRONOMICAL HIGH TIDE      9425000
## 9   ASTRONOMICAL LOW TIDE       320000
## 10               AVALANCE            0
```

Results

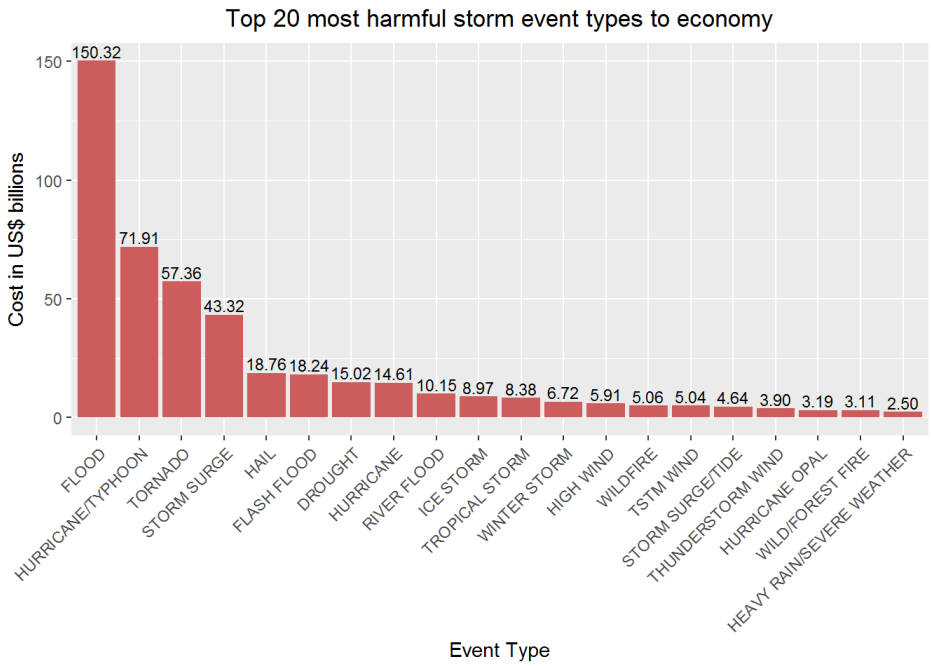
Top 20 types of storm events which are most harmful to population health.

```
n <- 20
topCasualtiesByEvtype <- slice(casualtiesByEvtype, order(-casualtiesByEvtype$casualties)[1:n])

ggplot(topCasualtiesByEvtype, aes(x=reorder(EVTYPE, -casualties), y = casualties)) +
        geom_bar(stat="identity", fill = "indianred") +
        geom_text(aes(label=paste(sprintf("%d", casualties))), position=position_dodge(width=0.9), vjust=-0.25,
size=3) +
        labs(title = "Top 20 most harmful storm event types to population health", x = "Event Type", y = "Casua
lties") +
        theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
        theme(plot.title = element_text(hjust = 0.5))
```



Top 20 types of storm events with greatest economic impact.

```
n <- 20
topEconomicCostByEvtype <- slice(economicCostByEvtype, order(-economicCostByEvtype$economicCost)[1:n])

ggplot(topEconomicCostByEvtype, aes(x=reorder(EVTYPE, -economicCost), y = economicCost/10^9)) +
        geom_bar(stat="identity", fill = "indianred") +
        geom_text(aes(label=paste(sprintf("%.02f", economicCost/10^9))), position=position_dodge(width=0.9), vj
ust=-0.25, size=3) +
        labs(title = "Top 20 most harmful storm event types to economy", x = "Event Type", y = "Cost in US$ bil
lions") +
        theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
        theme(plot.title = element_text(hjust = 0.5))
```


Top 20 most harmful storm event types to economy
Cost in US$ billions
150
100
50
0
150.32
71.91
57.36
43.32
18.76
18.24
15.02
14.61
10.15
8.97
8.38
6.72
5.91
5.06
5.04
4.64
3.90
3.19
3.11
2.50
FLOOD
HURRICANE/TYPHOON
TORNADO
STORM SURGE
HAIL
FLASH FLOOD
DROUGHT
HURRICANE
RIVER FLOOD
ICE STORM
TROPICAL STORM
WINTER STORM
HIGH WIND
WILDFIRE
TSTM WIND
STORM SURGE/TIDE
THUNDERSTORM WIND
HURRICANE OPAL
WILD/FOREST FIRE
HEAVY RAIN/SEVERE WEATHER
Event Type