CourseProject2

RUCHIKA LALLA_2048130

10/9/2020

ANALYSIS OF STORM DATA

Loading the required libraries

```
library(ggplot2)
library(plyr)
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:plyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize

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

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

Loading the data

```
if(!exists("storm.data")) {
    storm.data <- read.csv(bzfile("repdata_data_StormData.csv.bz2"),header =
TRUE)
  }
```

Analyze the dataset

```
dim(storm.data)

## [1] 902297     37

str(storm.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 ...
```

Extraction of Important Variables

```
vars <- c( "EVTYPE", "FATALITIES", "INJURIES", "PROPDMG", "PROPDMGEXP",
"CROPDMG", "CROPDMGEXP")
mydata <- storm.data[, vars]

tail(mydata)

##                EVTYPE FATALITIES INJURIES PROPDMG PROPDMGEXP CROPDMG
CROPDMGEXP
## 902292 WINTER WEATHER          0        0       0          K       0
K
## 902293      HIGH WIND          0        0       0          K       0
K
## 902294      HIGH WIND          0        0       0          K       0
K
```

```
## 902295      HIGH WIND          0        0       0          K       0
K
## 902296       BLIZZARD          0        0       0          K       0
K
## 902297     HEAVY SNOW          0        0       0          K       0
K
```

Checking for missing values

```
sum(is.na(mydata$FATALITIES))
```

```
## [1] 0
```

```
sum(is.na(mydata$INJURIES))
```

```
## [1] 0
```

```
sum(is.na(mydata$PROPDMG))
```

```
## [1] 0
```

```
sum(is.na(mydata$CROPDMG))
```

```
## [1] 0
```

```
sum(is.na(mydata$PROPDMGEXP))
```

```
## [1] 0
```

```
sum(is.na(mydata$CROPDMGEXP))
```

```
## [1] 0
```

Transformation of extracted variables

```
sort(table(mydata$EVTYPE), decreasing = TRUE)[1:10]
```

```
##
##               HAIL          TSTM WIND  THUNDERSTORM WIND
TORNADO
##             288661             219940              82563
60652
##        FLASH FLOOD              FLOOD THUNDERSTORM WINDS          HIGH
WIND
##              54277              25326              20843
20212
##          LIGHTNING         HEAVY SNOW
##              15754              15708
```

```
# create a new variable EVENT to transform variable EVTYPE in groups
mydata$EVENT <- "OTHER"
# group by keyword in EVTYPE
mydata$EVENT[grep("HAIL", mydata$EVTYPE, ignore.case = TRUE)] <- "HAIL"
mydata$EVENT[grep("HEAT", mydata$EVTYPE, ignore.case = TRUE)] <- "HEAT"
```

```r
mydata$EVENT[grep("FLOOD", mydata$EVTYPE, ignore.case = TRUE)] <- "FLOOD"
mydata$EVENT[grep("WIND", mydata$EVTYPE, ignore.case = TRUE)] <- "WIND"
mydata$EVENT[grep("STORM", mydata$EVTYPE, ignore.case = TRUE)] <- "STORM"
mydata$EVENT[grep("SNOW", mydata$EVTYPE, ignore.case = TRUE)] <- "SNOW"
mydata$EVENT[grep("TORNADO", mydata$EVTYPE, ignore.case = TRUE)] <- "TORNADO"
mydata$EVENT[grep("WINTER", mydata$EVTYPE, ignore.case = TRUE)] <- "WINTER"
mydata$EVENT[grep("RAIN", mydata$EVTYPE, ignore.case = TRUE)] <- "RAIN"
# listing the transformed event types
sort(table(mydata$EVENT), decreasing = TRUE)

##
##    HAIL    WIND   STORM   FLOOD TORNADO   OTHER  WINTER    SNOW    RAIN
HEAT
##  289270  255362  113156   82686   60700   48970   19604   17660   12241
2648

sort(table(mydata$PROPDMGEXP), decreasing = TRUE)[1:10]

##
##             K      M      0      B      5      1      2      ?      m
## 465934 424665  11330    216     40     28     25     13      8      7

sort(table(mydata$CROPDMGEXP), decreasing = TRUE)[1:10]

##
##             K      M      k      0      B      ?      2      m   <NA>
## 618413 281832   1994     21     19      9      7      1      1

mydata$PROPDMGEXP <- as.character(mydata$PROPDMGEXP)
mydata$PROPDMGEXP[is.na(mydata$PROPDMGEXP)] <- 0 # NA's considered as dollars
mydata$PROPDMGEXP[!grepl("K|M|B", mydata$PROPDMGEXP, ignore.case = TRUE)] <-
0 # everything exept K,M,B is dollar
mydata$PROPDMGEXP[grep("K", mydata$PROPDMGEXP, ignore.case = TRUE)] <- "3"
mydata$PROPDMGEXP[grep("M", mydata$PROPDMGEXP, ignore.case = TRUE)] <- "6"
mydata$PROPDMGEXP[grep("B", mydata$PROPDMGEXP, ignore.case = TRUE)] <- "9"
mydata$PROPDMGEXP <- as.numeric(as.character(mydata$PROPDMGEXP))
mydata$property.damage <- mydata$PROPDMG * 10^mydata$PROPDMGEXP

mydata$CROPDMGEXP <- as.character(mydata$CROPDMGEXP)
mydata$CROPDMGEXP[is.na(mydata$CROPDMGEXP)] <- 0 # NA's considered as dollars
mydata$CROPDMGEXP[!grepl("K|M|B", mydata$CROPDMGEXP, ignore.case = TRUE)] <-
0 # everything exept K,M,B is dollar
mydata$CROPDMGEXP[grep("K", mydata$CROPDMGEXP, ignore.case = TRUE)] <- "3"
mydata$CROPDMGEXP[grep("M", mydata$CROPDMGEXP, ignore.case = TRUE)] <- "6"
mydata$CROPDMGEXP[grep("B", mydata$CROPDMGEXP, ignore.case = TRUE)] <- "9"
mydata$CROPDMGEXP <- as.numeric(as.character(mydata$CROPDMGEXP))
mydata$crop.damage <- mydata$CROPDMG * 10^mydata$CROPDMGEXP

sort(table(mydata$property.damage), decreasing = TRUE)[1:10]
```

```
##
##      0   5000  10000   1000   2000  25000  50000   3000  20000  15000
## 663123  31731  21787  17544  17186  17104  13596  10364   9179   8617
```

```
sort(table(mydata$crop.damage), decreasing = TRUE)[1:10]
```

```
##
##      0   5000  10000  50000  1e+05   1000   2000  25000  20000  5e+05
## 880198   4097   2349   1984   1233    956    951    830    758    721
```

Analysis

Aggregating events for public health variables

```
# aggregate FATALITIES and INJURIES by type of EVENT
agg.fatalites.and.injuries <- ddply(mydata, .(EVENT), summarize, Total =
sum(FATALITIES + INJURIES,  na.rm = TRUE))
agg.fatalites.and.injuries$type <- "fatalities and injuries"

# aggregate FATALITIES by type of EVENT
agg.fatalities <- ddply(mydata, .(EVENT), summarize, Total = sum(FATALITIES,
na.rm = TRUE))
agg.fatalities$type <- "fatalities"

# aggregate INJURIES by type of EVENT
agg.injuries <- ddply(mydata, .(EVENT), summarize, Total = sum(INJURIES,
na.rm = TRUE))
agg.injuries$type <- "injuries"

# combine all
agg.health <- rbind(agg.fatalities, agg.injuries)

health.by.event <- join (agg.fatalities, agg.injuries, by="EVENT",
type="inner")
health.by.event
```

```
##      EVENT Total       type Total     type
## 1    FLOOD  1524 fatalities  8602 injuries
## 2     HAIL    15 fatalities  1371 injuries
## 3     HEAT  3138 fatalities  9224 injuries
## 4    OTHER  2626 fatalities 12224 injuries
## 5     RAIN   114 fatalities   305 injuries
## 6     SNOW   164 fatalities  1164 injuries
## 7    STORM   416 fatalities  5339 injuries
## 8  TORNADO  5661 fatalities 91407 injuries
## 9     WIND  1209 fatalities  9001 injuries
## 10  WINTER   278 fatalities  1891 injuries
```

Aggregating events for economic variables

```
# aggregate PropDamage and CropDamage by type of EVENT
agg.propdmg.and.cropdmg <- ddply(mydata, .(EVENT), summarize, Total =
```

```
sum(property.damage + crop.damage,  na.rm = TRUE))
agg.propdmg.and.cropdmg$type <- "property and crop damage"

# aggregate PropDamage by type of EVENT
agg.prop <- ddply(mydata, .(EVENT), summarize, Total = sum(property.damage,
na.rm = TRUE))
agg.prop$type <- "property"

# aggregate INJURIES by type of EVENT
agg.crop <- ddply(mydata, .(EVENT), summarize, Total = sum(crop.damage, na.rm
= TRUE))
agg.crop$type <- "crop"

# combine all
agg.economic <- rbind(agg.prop, agg.crop)


economic.by.event <- join (agg.prop, agg.crop, by="EVENT", type="inner")
economic.by.event
```

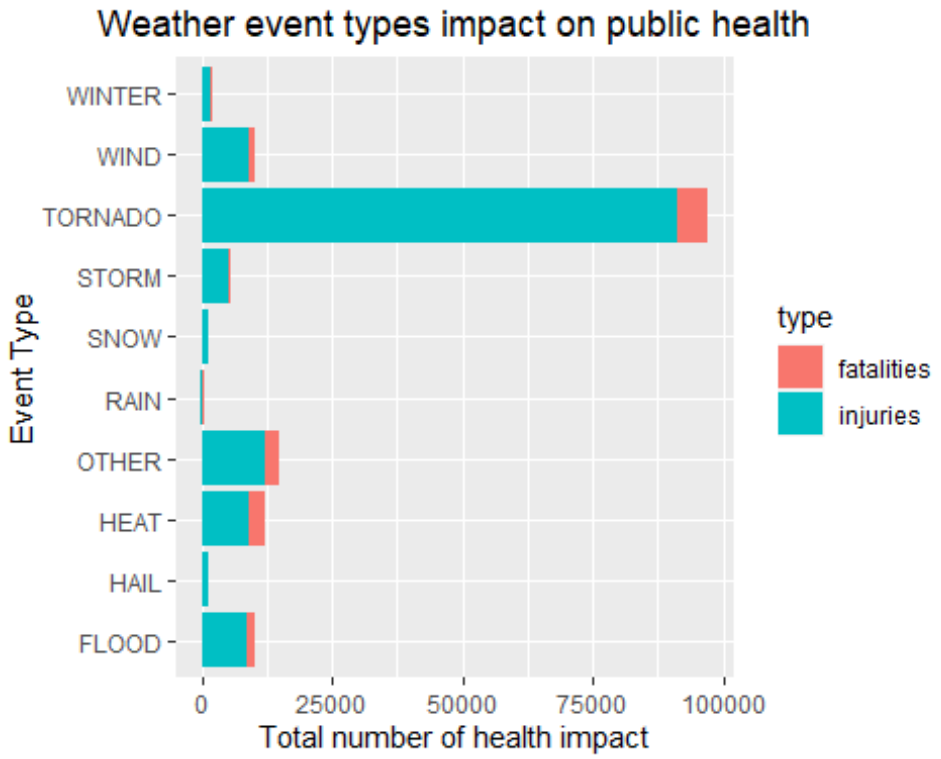
```
##       EVENT        Total     type       Total type
## 1    FLOOD 167502193929 property 12266906100 crop
## 2     HAIL  15733043048 property  3046837473 crop
## 3     HEAT     20325750 property   904469280 crop
## 4    OTHER  97246712337 property 23588880870 crop
## 5     RAIN   3270230192 property   919315800 crop
## 6     SNOW   1024169752 property   134683100 crop
## 7    STORM  66304415393 property  6374474888 crop
## 8  TORNADO  58593098029 property   417461520 crop
## 9     WIND  10847166618 property  1403719150 crop
## 10  WINTER   6777295251 property    47444000 crop
```

Results

Across the United States, which types of events are most harmful with respect to population health?

```
# transform EVENT to factor variable for health variables
agg.health$EVENT <- as.factor(agg.health$EVENT)

# plot FATALITIES and INJURIES by EVENT
health.plot <- ggplot(agg.health, aes(x = EVENT, y = Total, fill = type)) +
geom_bar(stat = "identity") +
  coord_flip() +
  xlab("Event Type") +
  ylab("Total number of health impact") +
  ggtitle("Weather event types impact on public health") +
  theme(plot.title = element_text(hjust = 0.5))
print(health.plot)
```

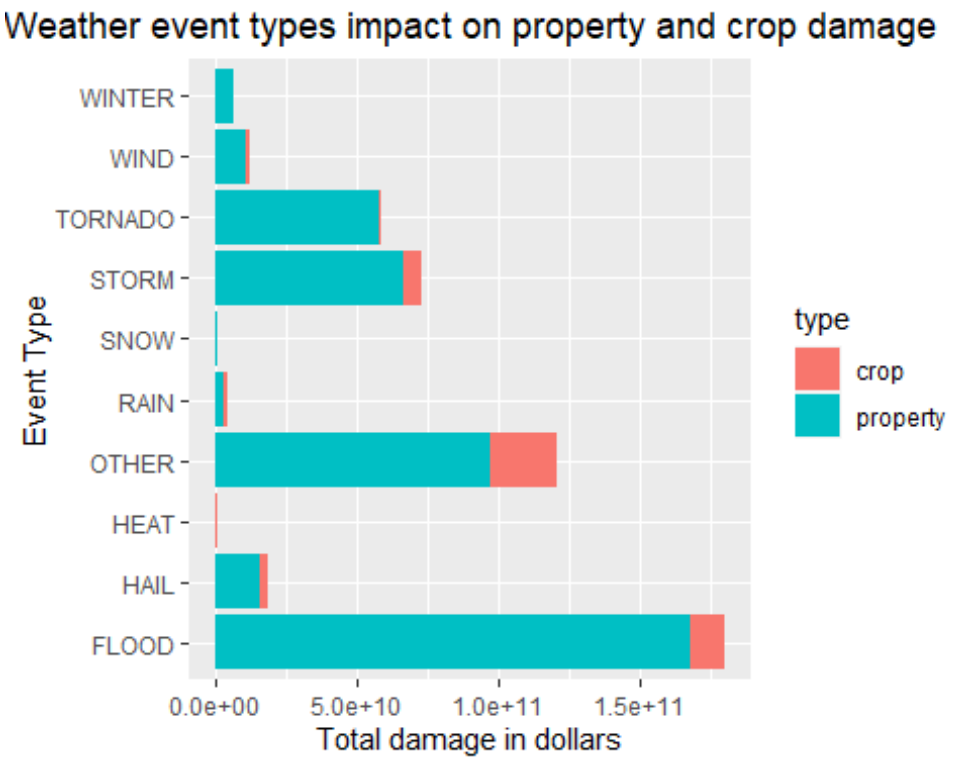


The most harmful weather event for health (in number of total fatalites and injuries) is, by far, a tornado.

Across the United States, which types of events have the greatest economic consequences?

```
# # transform EVENT to factor variable for economic variables
agg.economic$EVENT <- as.factor(agg.economic$EVENT)

# plot PROPERTY damage and CROP damage by EVENT
economic.plot <- ggplot(agg.economic, aes(x = EVENT, y = Total, fill = type))
+ geom_bar(stat = "identity") +
  coord_flip() +
  xlab("Event Type") +
  ylab("Total damage in dollars") +
  ggtitle("Weather event types impact on property and crop damage") +
  theme(plot.title = element_text(hjust = 0.5))
print(economic.plot)
```



The most devastating weather event with the greatest economic cosequences (to property and crops) is a flood.