

Health and Economic Consequences of Storms: 1950 - 2011

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Contents

0.0.1 Synopsis

This report explores the NOAA Storm Database and shows the types of Events that are most harmful to population health and that cause the most property and crop damage.

0.0.2 Data Processing

```
strUrl <-"https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"
strFilename <-"stormdata.bz2"
strDataDir <-""
```

- If needed, download compressed data [file](#).

```
strPathFilename <-file.path(getwd(), strDataDir, strFilename, fsep = "/")
strPathFilename <-sub(pattern = "{2,}", replacement = "/", x = strPathFilename)
if (!file.exists(strPathFilename))
{
  download.file(url = strUrl, destfile = strPathFilename, mode = "wb")
}
```

- Read select columns into data frame df.

```
df <-read.csv(file = strPathFilename, stringsAsFactors = FALSE,
             colClasses = c(rep("NULL",7),"character",rep("NULL",14),
                         rep("numeric",3),"character","numeric","character",
                         rep("NULL",9)))
summary(df)
```

```
##      EVTYPE          FATALITIES      INJURIES
## Length:902297      Min.   : 0.0000      Min.   : 0.0000
## Class :character    1st Qu.: 0.0000      1st Qu.: 0.0000
## Mode  :character    Median : 0.0000      Median : 0.0000
##              Mean   : 0.0168      Mean   : 0.1557
##              3rd Qu.: 0.0000      3rd Qu.: 0.0000
##              Max.   :583.0000      Max.   :1700.0000
##      PROPDMG      PROPDMGEXP      CROPDMG      CROPDMGEXP
## Min.   : 0.00      Length:902297      Min.   : 0.000      Length:902297
## 1st Qu.: 0.00      Class :character    1st Qu.: 0.000      Class :character
## Median : 0.00      Mode  :character    Median : 0.000      Mode  :character
## Mean   : 12.06              Mean   : 1.527
## 3rd Qu.: 0.50              3rd Qu.: 0.000
## Max.   :5000.00              Max.   :990.000
```

- Calculate A New Event Group Variable (df\$EVTGROUP) to summarize the 985 event types.

```

df$EVTGROUP <-NA
#
df[grepl("^astro|^blow-out tide|^high tides",df$EVTYPE,ignore.case = TRUE),
  "EVTGROUP"] <-"Tides"
df[grepl("^aval",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Avalanche"
df[grepl("^blizz",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Blizzard"
df[grepl("^coastal flood",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Coastal Flood"
df[grepl("wind chill",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Wind Chill"
df[grepl("debris flow",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Debris Flow"
df[grepl("dense fog",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Dense Fog"
df[grepl("smoke",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Dense Smoke"
df[grepl("drought",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Drought"
df[grepl("dust devil",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Dust Devil"
df[grepl("^dust storm",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Dust Storm"
df[grepl("^excessive heat|record/excessive heat",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Excessive Heat"
df[grepl("extreme cold",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Extreme Cold/Wind Chill"
df[grepl("^flood|flooding$",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Flood"
df[grepl("^flash flood",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Flash Flood"
df[grepl("frost",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Forst/Freeze"
df[grepl("funnel",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Funnel Cloud"
df[grepl("freezing fog",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Freezing Fog"
df[grepl("hail",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Hail"
df[grepl("^excessive heat|^extreme heat|^record heat", df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Heat"
df[grepl("^heat|excessive heat$", df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Heat"
df[grepl("^heavy rain",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Heavy Rain"
df[grepl("^heavy snow|snow and heavy snow|snow/heavy snow",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Heavy Snow"
df[grepl("^high surf",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"High Surf"
df[grepl("^high wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"High Wind"
df[grepl("^hurricane|^typhoon",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Hurricane Typhoon"
df[grepl("^ice storm|glaze/ice storm|sleet/ice storm", df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Ice Storm"
df[grepl("snow and ice storm|snow/ice storm", df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <-"Ice Storm"

```

```

df[grepl("lake-effect snow",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Lake-Effect Snow"
df[grepl("lakeshore flood",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Lakeshore Flood"
df[grepl("^lightning",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Lightning"
df[grepl("marine hail",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Marine Hail"
df[grepl("marine high wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Marine High Wind"
df[grepl("marine strong wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Marine Strong Wind"
df[grepl("marine thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Marine Thunderstorm Wind"
df[grepl("rip current",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Rip Current"
df[grepl("seiche",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Seiche"
df[grepl("sleet|^freezing drizzle|^freezing rain",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Sleet"
df[grepl("storm surge",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Storm Surge"
df[grepl("^strong wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Strong Wind"
df[grepl("gusty thunderstorm wind|^severe thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Thunderstorm Wind"
df[grepl("^thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Thunderstorm Wind"
df[grepl("tornado",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Tornado"
df[grepl("tropical depression",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Tropical Depression"
df[grepl("tropical storm",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Tropical Storm"
df[grepl("tsunami",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Tsunami"
df[grepl("volcanic",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Volcanic Ash"
df[grepl("^waterspout",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Waterspout"
df[grepl("wildfire",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Wildfire"
df[grepl("^winter storm",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "WinterStorm"
df[grepl("winter weather",df$EVTYPE, ignore.case = TRUE),
  "EVTGROUP"] <- "Winter Weather"

```

- Calculate New Damage Amount Variables (df\$PROPDMGAMT & df\$CROPDMGAMT) for each event type.

```

df$PROPDMGAMT <- NA
#
df[grepl("[0-9]", df$PROPDMGEXP, "PROPDMGAMT") <- (10^as.numeric(df[grepl("[0-9]",
  df$PROPDMGEXP, ), "PROPDMGEXP"])) * df[grepl("[0-9]", df$PROPDMGEXP, ), "PROPDMG"]
df[grepl("B", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grepl("B",
  df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1e+09
df[grepl("M", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grepl("M",
  df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1e+06
df[grepl("K", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grepl("K",

```

```

df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1000
df[grep("H", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grep("H",
df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 100
#
df$CROPDMGAMT <- NA
#
df[grep("[0-9]", df$CROPDMGEXP), "CROPDMGAMT"] <- (10^as.numeric(df[grep("[0-9]",
df$CROPDMGEXP, ), "CROPDMGEXP"])) * df[grep("[0-9]", df$CROPDMGEXP, ), "CROPDMG"]
df[grep("B", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("B",
df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1e+09
df[grep("M", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("M",
df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1e+06
df[grep("K", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("K",
df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1000
df[grep("H", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("H",
df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 100

```

- Calculate New Total Vectors for Fatalities, Injuries, Property Damage and Crop Damage by Event Group (df\$EVTGROUP).

```

Fatalities <-tapply(X = df$FATALITIES, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
Injuries <-tapply(X = df$INJURIES, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
PropDmgAmt <-tapply(X = df$PROPDMGAMT, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
CropDmgAmt <-tapply(X = df$CROPDMGAMT, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)

```

0.0.3 Results

- Ranking of Event Groups by Population Fatalities.

```
(Fatalities <-sort(x = Fatalities, decreasing = TRUE))
```

##	Tornado	Heat	Flash Flood
##	5658	3138	1018
##	Lightning	Rip Current	Flood
##	817	577	501
##	High Wind	Extreme Cold/Wind Chill	Avalanche
##	293	287	225
##	WinterStorm	Thunderstorm Wind	Hurricane Typhoon
##	217	199	135
##	Heavy Snow	Strong Wind	High Surf
##	129	111	104
##	Blizzard	Heavy Rain	Wind Chill
##	101	98	95
##	Ice Storm	Wildfire	Tropical Storm
##	89	75	66
##	Winter Weather	Tsunami	Storm Surge
##	61	33	24
##	Dust Storm	Hail	Dense Fog
##	22	20	18
##	Marine Strong Wind	Sleet Marine Thunderstorm Wind	
##	14	12	10
##	Waterspout	Coastal Flood	Dust Devil
##	6	3	2
##	Forst/Freeze	Marine High Wind	Dense Smoke
##	1	1	0
##	Drought	Freezing Fog	Funnel Cloud

```
##           0           0           0
##      Lake-Effect Snow      Lakeshore Flood      Marine Hail
##           0           0           0
##           Seiche           Tides      Tropical Depression
##           0           0           0
##      Volcanic Ash
##           0
```

- Ranking of Event Groups by Population Injuries.

```
(Injuries <-sort(x = Injuries, decreasing = TRUE))
```

```
##           Tornado           Heat           Flood
##           91364           9224           6808
##      Lightning      Thunderstorm Wind      Ice Storm
##           5232           2402           1992
##      Flash Flood           High Wind           Hail
##           1785           1471           1466
##      WinterStorm      Hurricane Typhoon      Heavy Snow
##           1353           1333           1034
##      Wildfire           Blizzard           Winter Weather
##           911           805           538
##      Rip Current           Dust Storm           Tropical Storm
##           529           440           383
##      Dense Fog           Strong Wind      Extreme Cold/Wind Chill
##           342           301           255
##      Heavy Rain           Avalanche           High Surf
##           255           170           156
##      Tsunami           Waterspout           Dust Devil
##           129           72           43
##      Storm Surge           Sleet Marine Thunderstorm Wind
##           43           38           26
##      Marine Strong Wind           Wind Chill           Coastal Flood
##           22           12           7
##      Drought           Forst/Freeze           Funnel Cloud
##           4           3           3
##      Marine High Wind           Dense Smoke           Freezing Fog
##           1           0           0
##      Lake-Effect Snow      Lakeshore Flood      Marine Hail
##           0           0           0
##      Seiche           Tides      Tropical Depression
##           0           0           0
##      Volcanic Ash
##           0
```

- Plot Ranking of Event Groups by Fatalities and Injuries.

```
par(mfrow = c(2,1))
barplot(Fatalities[1:3], ylab = "Total Fatalities")
barplot(Injuries[1:3], ylab = "Total Injuries")
```

- Ranking of Event Groups by Property & Crop Damage.

```
(PropDmgAmt <-sort(x = PropDmgAmt, decreasing = TRUE))
```

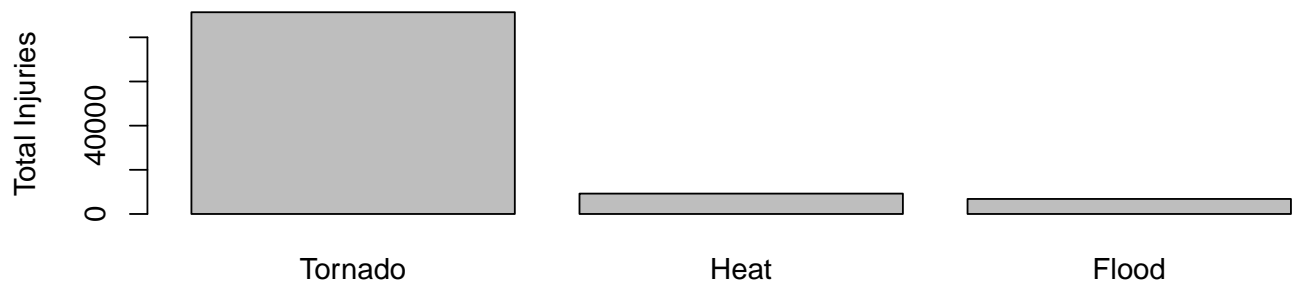
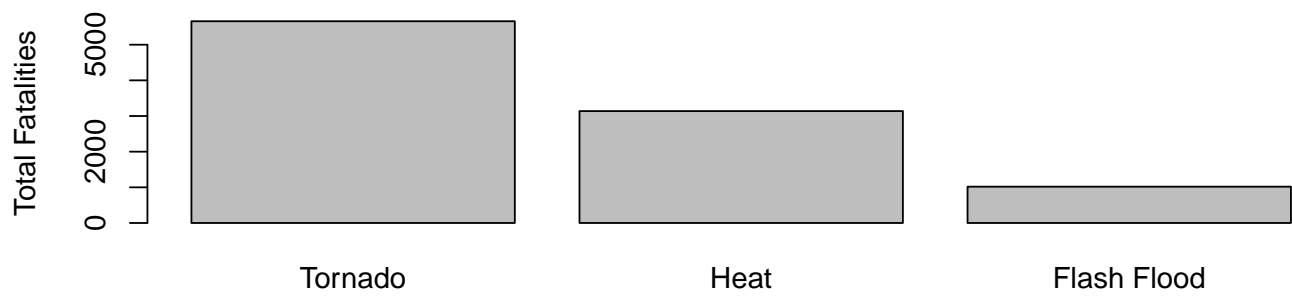


Figure 1:

##	Flood	Hurricane Typhoon	Tornado
##	145223640907	85356410010	58552151864
##	Storm Surge	Flash Flood	Hail
##	47964724000	17414680872	16021900956
##	Tropical Storm	WinterStorm	High Wind
##	7714390550	6748997251	6003352990
##	Thunderstorm Wind	Wildfire	Ice Storm
##	5431305978	4865614000	3945527860
##	Heavy Rain	Drought	Heavy Snow
##	3230998140	1046106000	953697140
##	Lightning	Blizzard	Coastal Flood
##	935452427	659713950	279600560
##	Strong Wind	Tsunami	High Surf
##	177674240	144062000	89955000
##	Extreme Cold/Wind Chill	Waterspout	Lake-Effect Snow
##	76385400	60730200	40115000
##	Winter Weather	Heat	Forst/Freeze
##	27298000	20325750	10995000
##	Sleet	Tides	Dense Fog
##	10366500	9745150	9674000
##	Lakeshore Flood	Dust Storm	Avalanche
##	7540000	5599000	3721800
##	Freezing Fog	Wind Chill	Tropical Depression
##	2182000	2040000	1737000
##	Marine High Wind	Seiche	Dust Devil
##	1297010	980000	719130
##	Volcanic Ash	Marine Thunderstorm Wind	Marine Strong Wind
##	500000	436400	418330
##	Funnel Cloud	Rip Current	Dense Smoke
##	194600	163000	100000
##	Marine Hail		
##	4000		

```
(CropDmgAmt <-sort(x = CropDmgAmt, decreasing = TRUE))
```

##	Drought	Flood	Hurricane Typhoon
##	13972566000	5912155450	5516117800
##	Ice Storm	Hail	Flash Flood
##	5022113500	3111633870	1437163150
##	Extreme Cold/Wind Chill	Forst/Freeze	Heat
##	1313023000	1202186000	904469280
##	Heavy Rain	Tropical Storm	High Wind
##	795752800	694896000	686301900
##	Thunderstorm Wind	Tornado	Wildfire
##	634694380	417461520	295972800
##	Heavy Snow	Blizzard	Strong Wind
##	134673100	112060000	69953500
##	WinterStorm	Winter Weather	Lightning
##	32444000	15000000	12092090
##	Dust Storm	Storm Surge	Wind Chill
##	3600000	855000	600000
##	Marine Thunderstorm Wind	Tsunami	Avalanche
##	50000	20000	0
##	Coastal Flood	Dense Fog	Dense Smoke
##	0	0	0
##	Dust Devil	Freezing Fog	Funnel Cloud
##	0	0	0
##	High Surf	Lake-Effect Snow	Lakeshore Flood

```
##           0           0           0
## Marine Hail      Marine High Wind      Marine Strong Wind
##           0           0           0
## Rip Current      Seiche      Sleet
##           0           0           0
## Tides      Tropical Depression      Volcanic Ash
##           0           0           0
## Waterspout
##           0
```

- Plot Ranking of Event Groups by Property & Crop Damage.

```
par(mfrow = c(1,1))
barplot(PropDmgAmt[1:3]/1000000000, ylab = "Total Property Damage - $Billions")
```

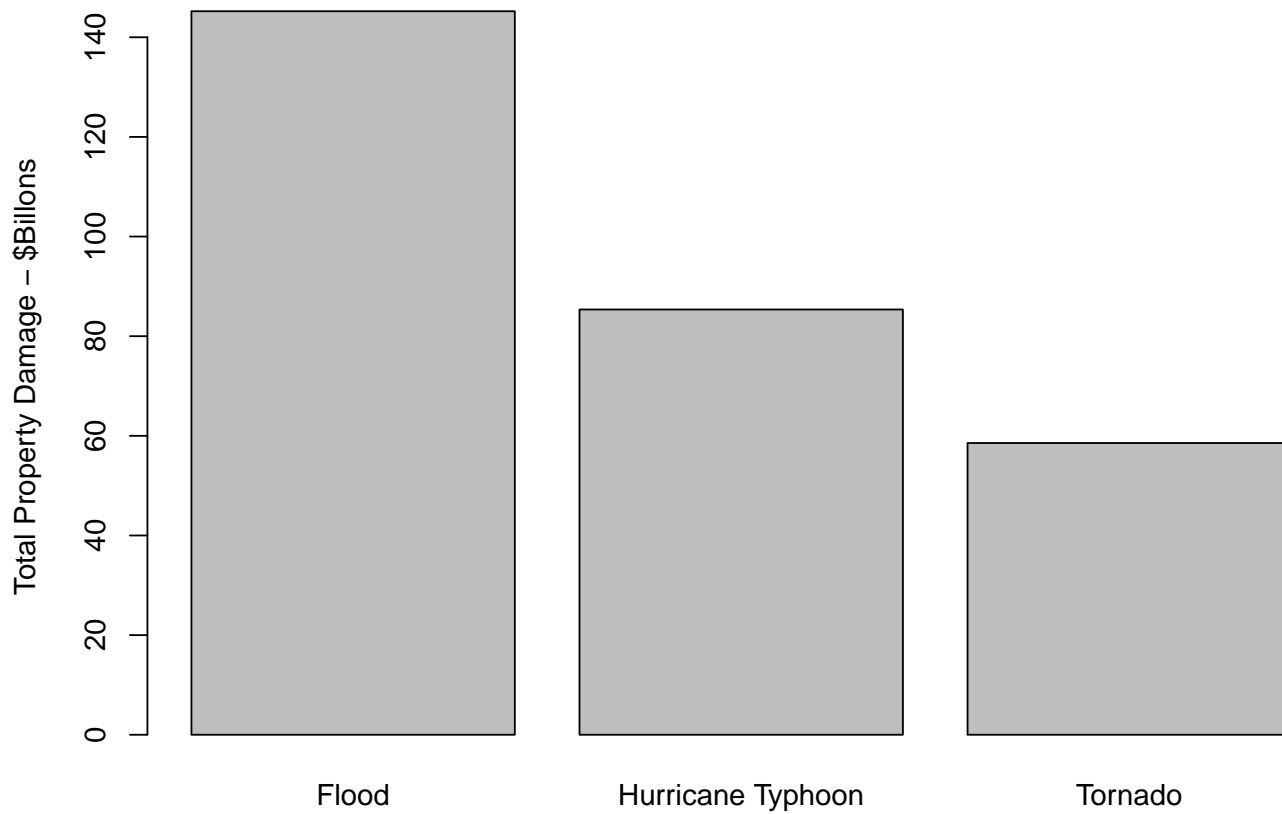


Figure 2:

```
barplot(CropDmgAmt[1:3]/1000000000, ylab = "Total Crop Damage - $Billions")
```

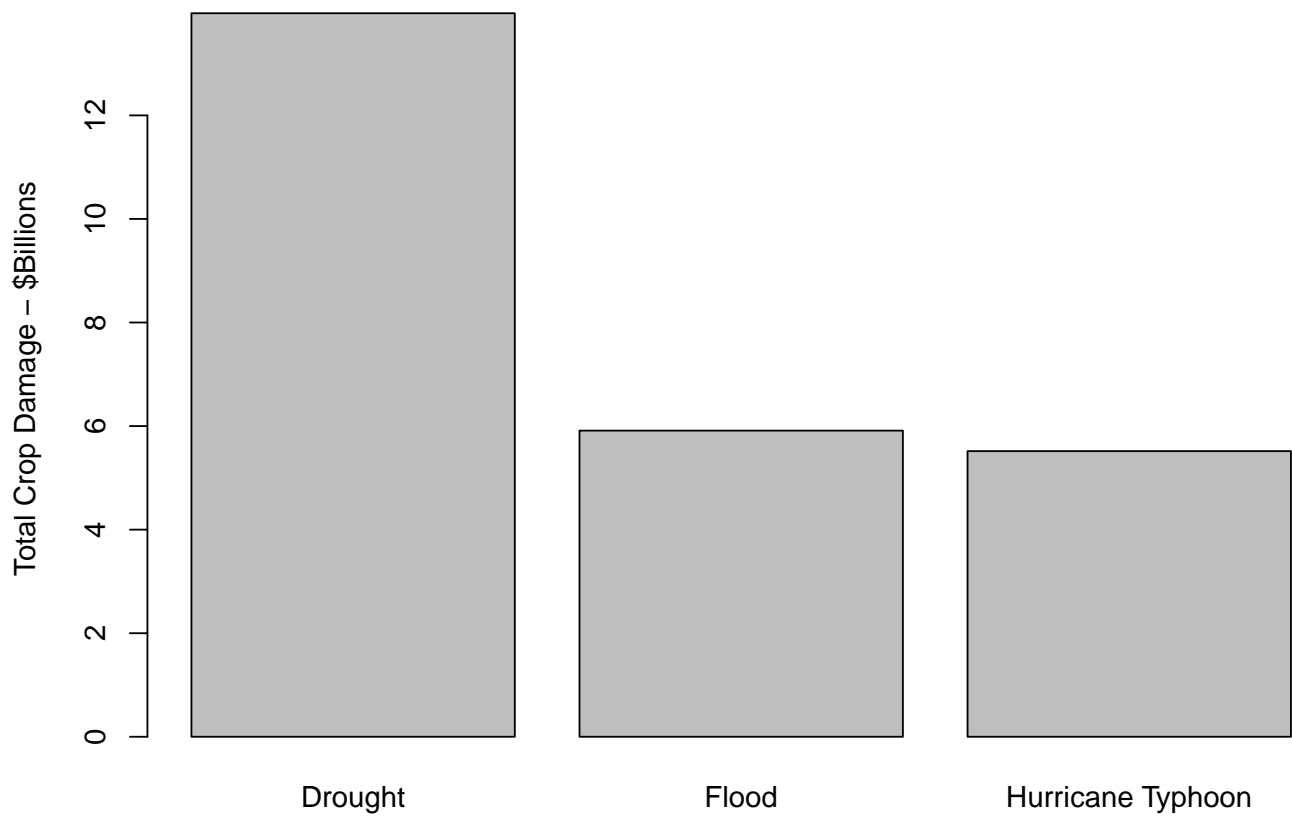



Figure 3: