STAT225

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Predicting Hurricane Deaths

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Purpose

We hope to predict the number of hurricane deaths based on variables such as maximum sustained windspeed, atmospheric pressure, and property damage from a dataset containing data on 94 named hurricanes that made landfall in the US mainland from 1950 through 2012. We would expect the number of deaths to increase as the maximum sustained windspeed and property damage increases, since it would make sense for more destructive hurricanes to also be more deadly.

Data

Source

We plan to use the dataset "hurricNamed" from the "DAAG" R package containing data on 94 named hurricanes that made landfall in the US mainland from 1950 through 2012. It contains information on the number of deaths, the name of the hurricane, the year of the hurricane, the damage caused by the hurricane, etc. The data is sourced from multiple places and was used in a research paper claiming that hurricanes with female names did more human damage (after adjusting for the severity of the storm) than those with male names. Therefore, the data seems fairly reliable.

Response Variables

Our response variable is the number of deaths that occurred due to a hurricane. The units are number of human deaths. We observe that the range of deaths are from 0 to 1836.

Explanatory Variables

The explanatory variables we will examine are LF.WindsMPH, LF.PressureMB, LF.times, BaseDam2014, NDAM2014, and deaths.

1. LF.WindsMPH describes the maximum sustained windspeed for each hurricane in miles per hour
2. LF.PressureMB describes the atmospheric pressure at landfall in millibars
3. LF.times describes the number of times the hurricane made landfall

4. BaseDam2014 describes the property damage caused by the hurricane in millions of 2014 US dollars
5. NDAM2014 describes the amount of damage the hurricane caused had it appeared in 2014 (no units given)
6. deaths describes the number of human deaths the hurricane caused

```
# load in full dataset
full_hurricane_df <- hurricNamed
glimpse(full_hurricane_df)
```

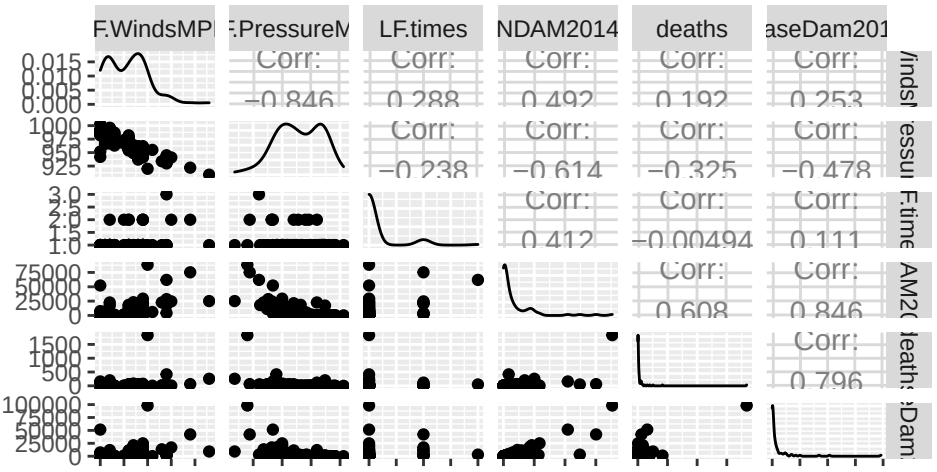
```
## Rows: 94
## Columns: 12
## $ Name           <chr> "Easy", "King", "Able", "Barbara", "Florence", "Caro...
## $ Year           <int> 1950, 1950, 1952, 1953, 1953, 1954, 1954, 1954, 1955...
## $ LF.WindsMPH    <int> 120, 130, 85, 85, 85, 120, 120, 145, 120, 85, 120, 1...
## $ LF.PressureMB  <int> 958, 955, 985, 987, 985, 960, 954, 938, 962, 987, 96...
## $ LF.times       <int> 1, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 3, 1...
## $ BaseDamage     <dbl> 3.3000, 28.0000, 2.7500, 1.0000, 0.2000, 460.2275, 4...
## $ NDAM2014       <dbl> 1870, 6030, 170, 65, 18, 21375, 3520, 28500, 2270, 1...
## $ AffectedStates <chr> "FL", "FL", "SC", "NC", "FL", "NC,NY,CT,RI", "MA,ME"...
## $ firstLF        <date> 1950-09-04, 1950-10-17, 1952-08-30, 1953-08-13, 195...
## $ deaths         <int> 2, 4, 3, 1, 0, 60, 20, 20, 0, 200, 7, 15, 416, 1, 0,...
## $ mf             <fct> f, m, m, f, f, f, f, f, f, f, m, f, f, f, f, f, f, f...
## $ BaseDam2014    <dbl> 32.419419, 275.073859, 24.569434, 8.867416, 1.773483...
```

```
# remove non numeric and BaseDamage for ggpairs call
hurricane_numeric <- full_hurricane_df %>%
  select(-c(Name, AffectedStates, firstLF, mf, BaseDamage, Year))

# removing death outlier
hurricane_death_outlier <- hurricane_numeric %>%
  filter(deaths != 1836)

# applying a log transformation to deaths
hurricane_logdeaths <- hurricane_numeric %>%
  mutate(log_deaths = ifelse(deaths == 0, 0, log(deaths))) %>%
  select(-deaths)
```

Exploratory Data Analysis

GGpairs calls

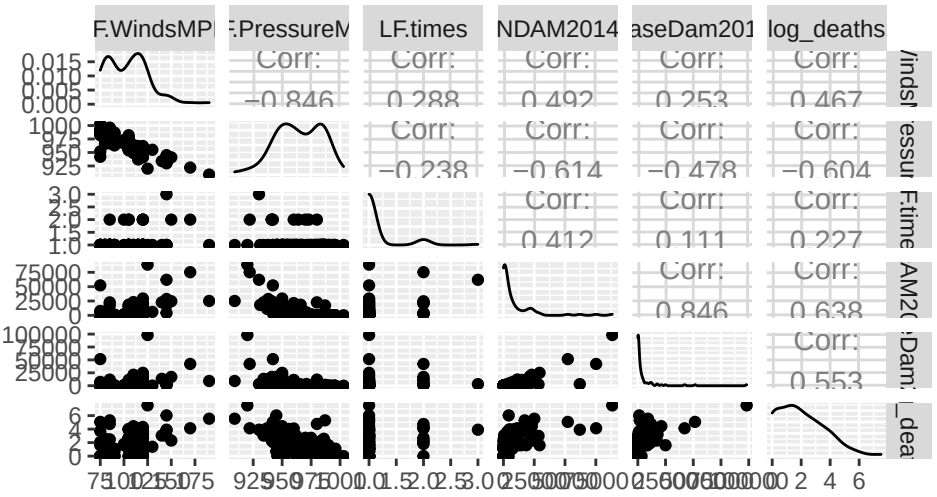
```
ggpairs(hurricane_numeric)
```



talk about ggpairs here and how deaths looks bad

now we try log transformation on deaths:

```
ggpairs(hurricane_logdeaths)
```



talk about above ggpairs calls here

correlation test?

one of the following tests / corresponding CI ADI binomial test fisher's sign test wilcoxon signed rank test permutation/randomization test kendalls tau or spearman's correlation test ADI

Kolmogorov Smirnov Test

kolmogorov smirnov test (with empirical CDF(s) plotted) LEAH

Kernel Density Estimation

kernel density estimation (not smoothing related) LEAH

OLS multiple linear regression

OLS multiple linear regression (for comparison purposes) OLIVER

```
# different models to predict log deaths
pressure_windspeed <- msummary(lm(log_deaths ~ LF.PressureMB + LF.WindsMPH,
                                  data = hurricane_logdeaths)) ;pressure_windspeed
```

```
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   62.56484   13.70080   4.567 1.55e-05 ***
## LF.PressureMB -0.06163    0.01313  -4.693 9.45e-06 ***
## LF.WindsMPH   -0.01120    0.01154  -0.971    0.334
##
## Residual standard error: 1.334 on 91 degrees of freedom
## Multiple R-squared:  0.3708, Adjusted R-squared:  0.357
## F-statistic: 26.81 on 2 and 91 DF,  p-value: 6.994e-10
```

```
pressure_ndam <- msummary(lm(log_deaths ~ LF.PressureMB + NDAM2014,
                                  data = hurricane_logdeaths)) ;pressure_ndam
```

```
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)    2.916e+01  7.837e+00   3.721 0.000343 ***
## LF.PressureMB -2.862e-02  8.070e-03  -3.546 0.000620 ***
## NDAM2014       4.668e-05  1.040e-05   4.489 2.09e-05 ***
##
## Residual standard error: 1.213 on 91 degrees of freedom
## Multiple R-squared:  0.4795, Adjusted R-squared:  0.4681
## F-statistic: 41.92 on 2 and 91 DF,  p-value: 1.248e-13
```

```
pressure_basedam <- msummary(lm(log_deaths ~ LF.PressureMB + BaseDam2014,
                                  data = hurricane_logdeaths)) ;pressure_basedam
```

```
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)    3.747e+01  7.187e+00   5.213 1.15e-06 ***
## LF.PressureMB -3.705e-02  7.424e-03  -4.991 2.87e-06 ***
## BaseDam2014    4.514e-05  1.161e-05   3.888 0.000192 ***
##
## Residual standard error: 1.242 on 91 degrees of freedom
## Multiple R-squared:  0.4548, Adjusted R-squared:  0.4428
## F-statistic: 37.96 on 2 and 91 DF,  p-value: 1.029e-12
```

JHM Multiple Regression

rfit JHM multiple regression OLIVER

Generalized Additive Model

generalized additive model (which will require you attempting a variety of smoothers) ADI

Results

table of aggregated results and discussion of findings

Limitations

only data from US, small number of observations, small number of predictors for deaths

Potential shortcomings of the dataset include limited data on weather-related variables for each hurricane, as it only contains maximum sustained windspeed, atmospheric pressure at landfall, and number of landfalls. Additionally, the "NDAM2014" column contains data on hurricane damage had the hurricane appeared in 2014 and it is unclear how these estimates were calculated (also no units are given on these observations).

Conclusion