# When Do We Need Emergency Services?

Analysing Vic Roads crash data

August 2023

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# Why?

How many emergency services do we need?

Should we reallocate the current distribution?

Where should we send Ambulances & Police in the moment?

# How?

The crash data!

- Find key metrics
- Group the crashes
- Number of times 000 arrived
- Create a statical model

# Major steps

Investigating data structure

General data wrangling

Viewing initial trends

Further data cleaning

Final statistical model

# Investigating Structure & Wrangling Data

# Initial Data Structure

## Pre-Crash data

- Time of accident
- Atmospheric condition
- Road condition
- Local Government Area (LGA)
- Light Condition

## Post-Crash data

- Severity
- Number of people involved
- Accident Type
- Police Needed
- Ambulance Needed

# Simplifying Data

## Pre-Crash data

- Day of the week
- Part of the day
- Atmospheric condition
- Road condition
- LGA / Region

## Post-Crash data

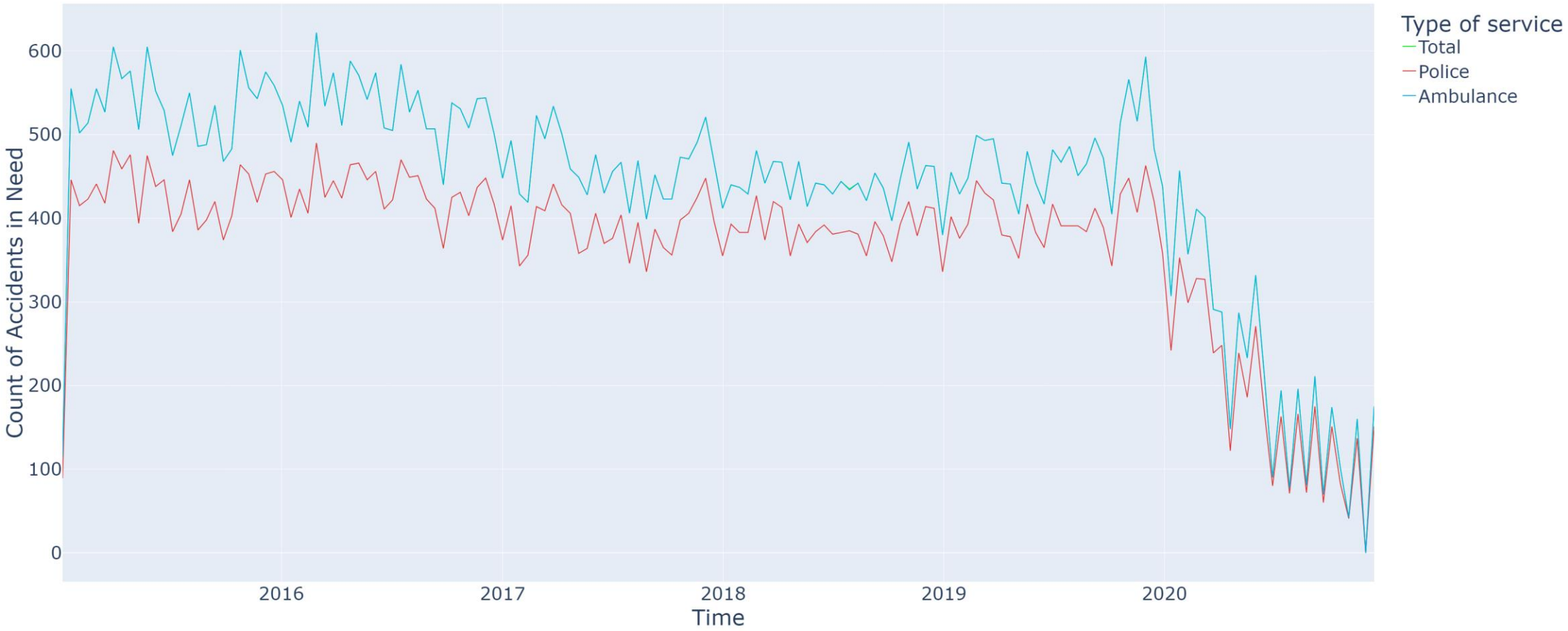
- Police Needed
- Ambulance Needed

# Ambulance Needed

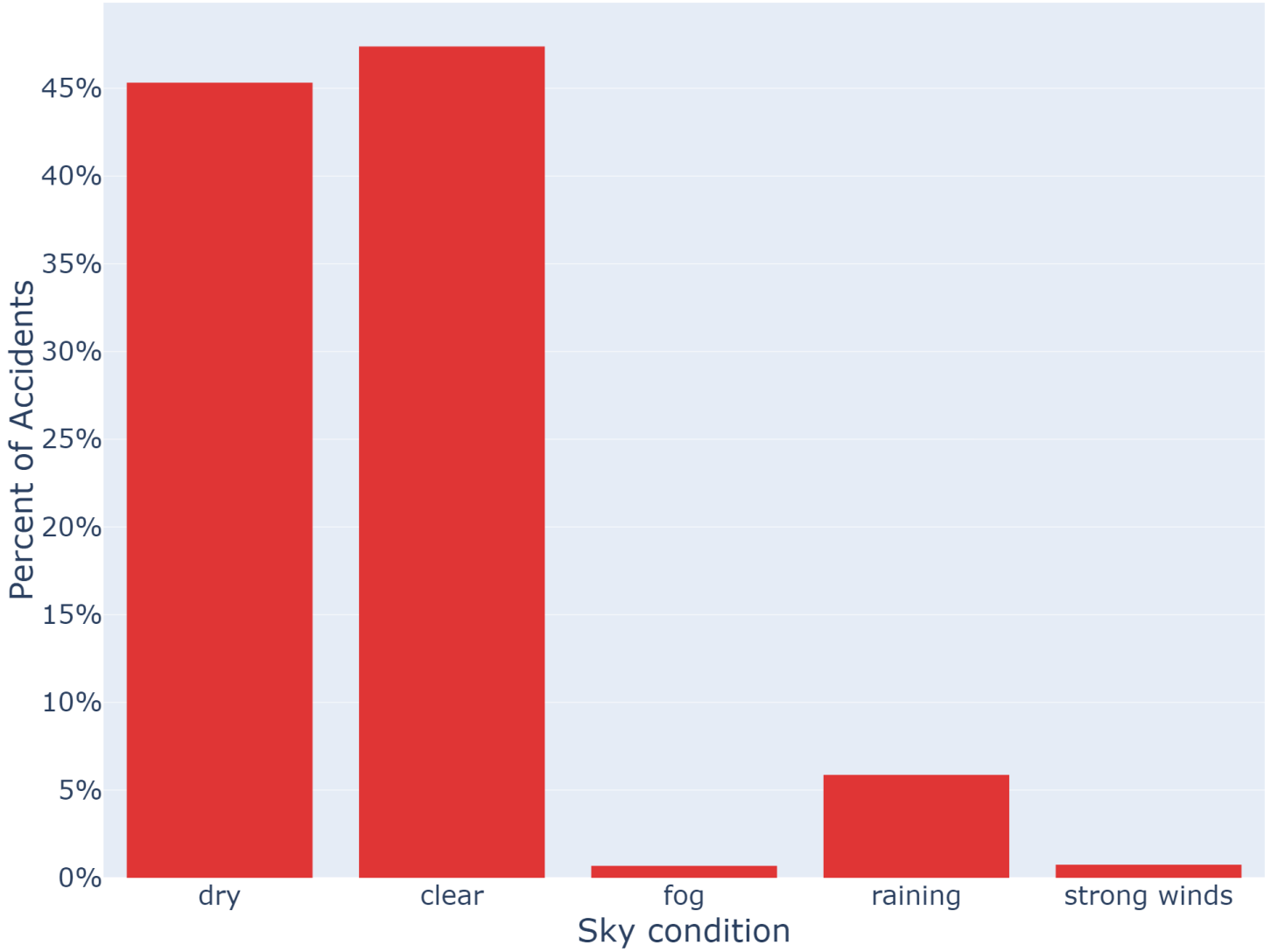
- Only one ambulance per crash
- Each person of a crash had their injury severity recorded
- If someone was taken to the hospital, it was recorded

# Viewing Initial Trends

# Emergency Callouts Over Time (Fortnightly)

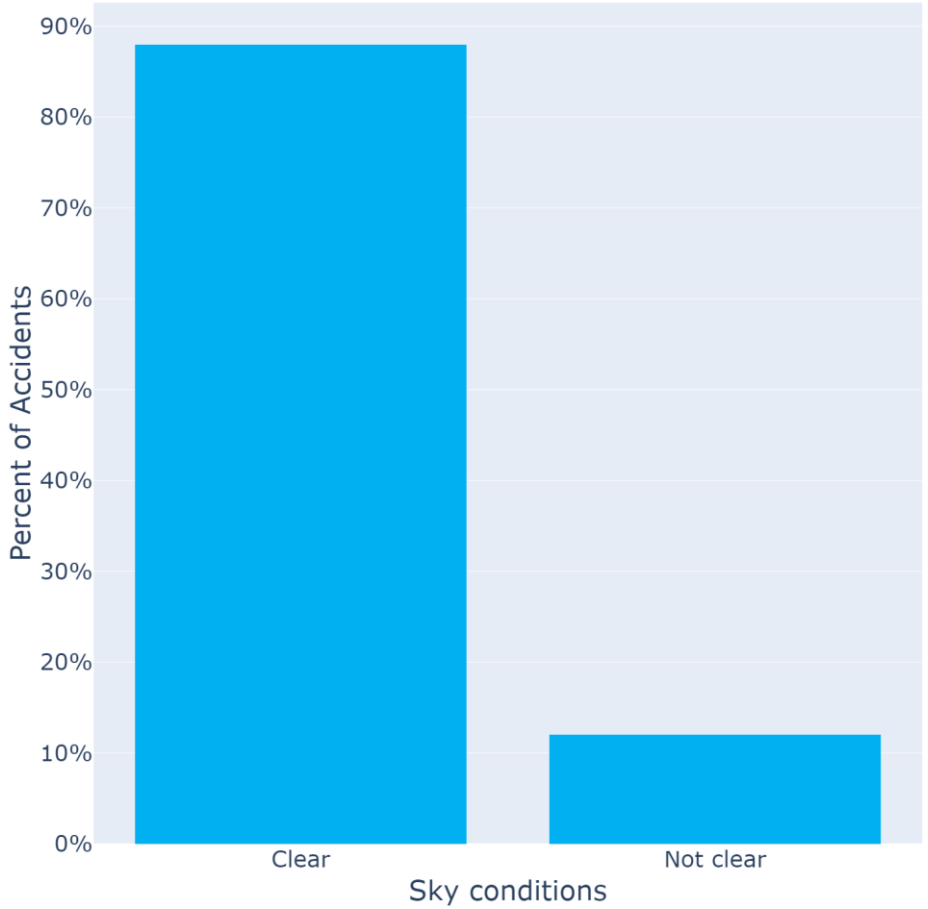


# Crashes by Road and Sky Conditions

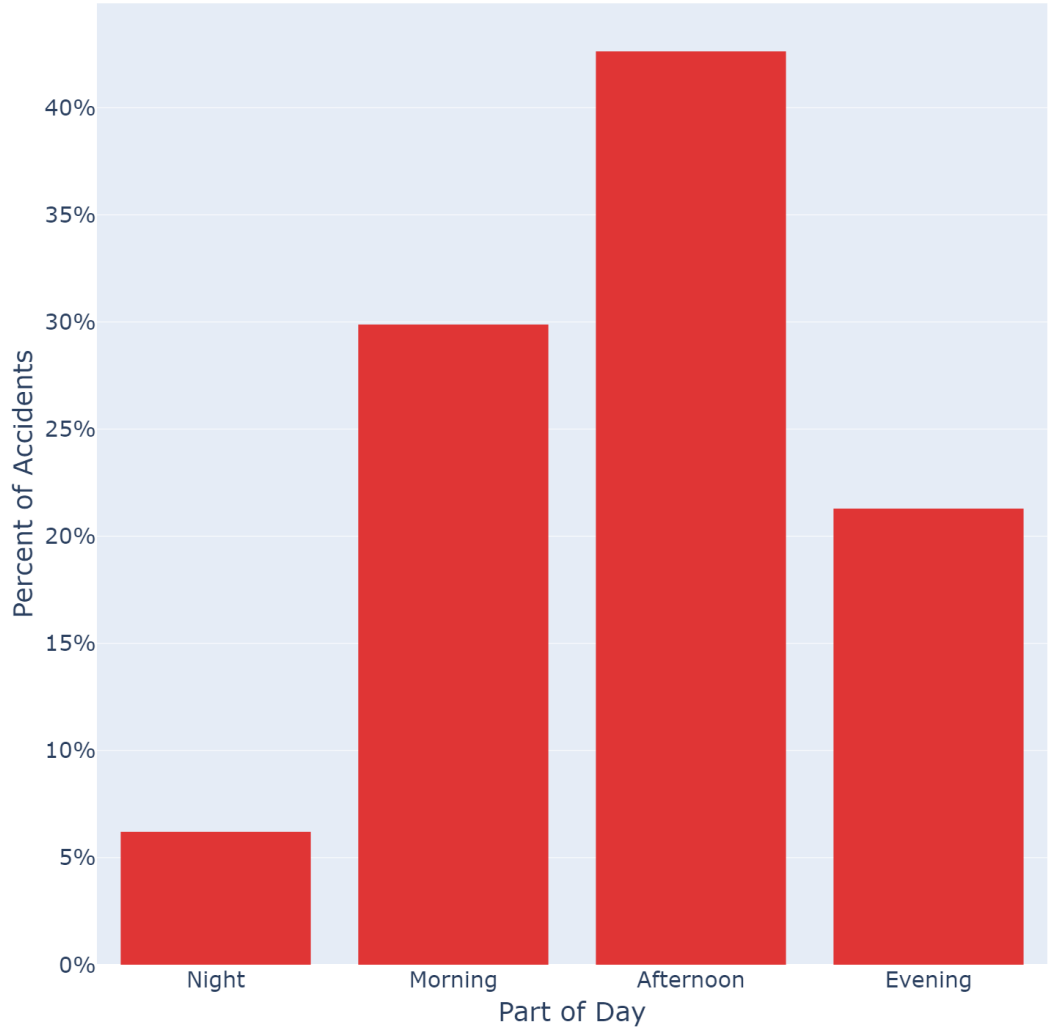


# Correlation of Conditions

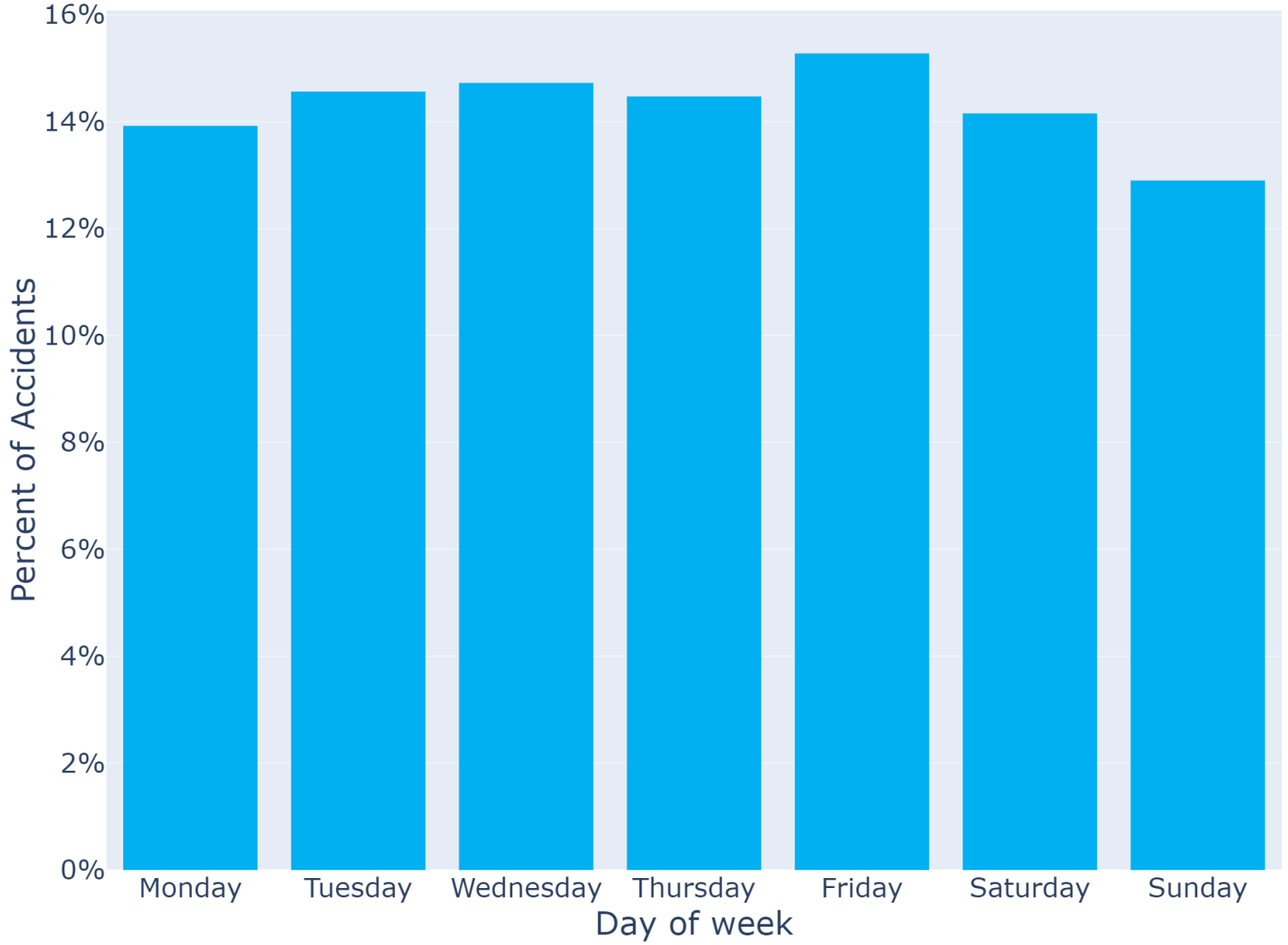
# Emergency Callouts by Sky Conditions



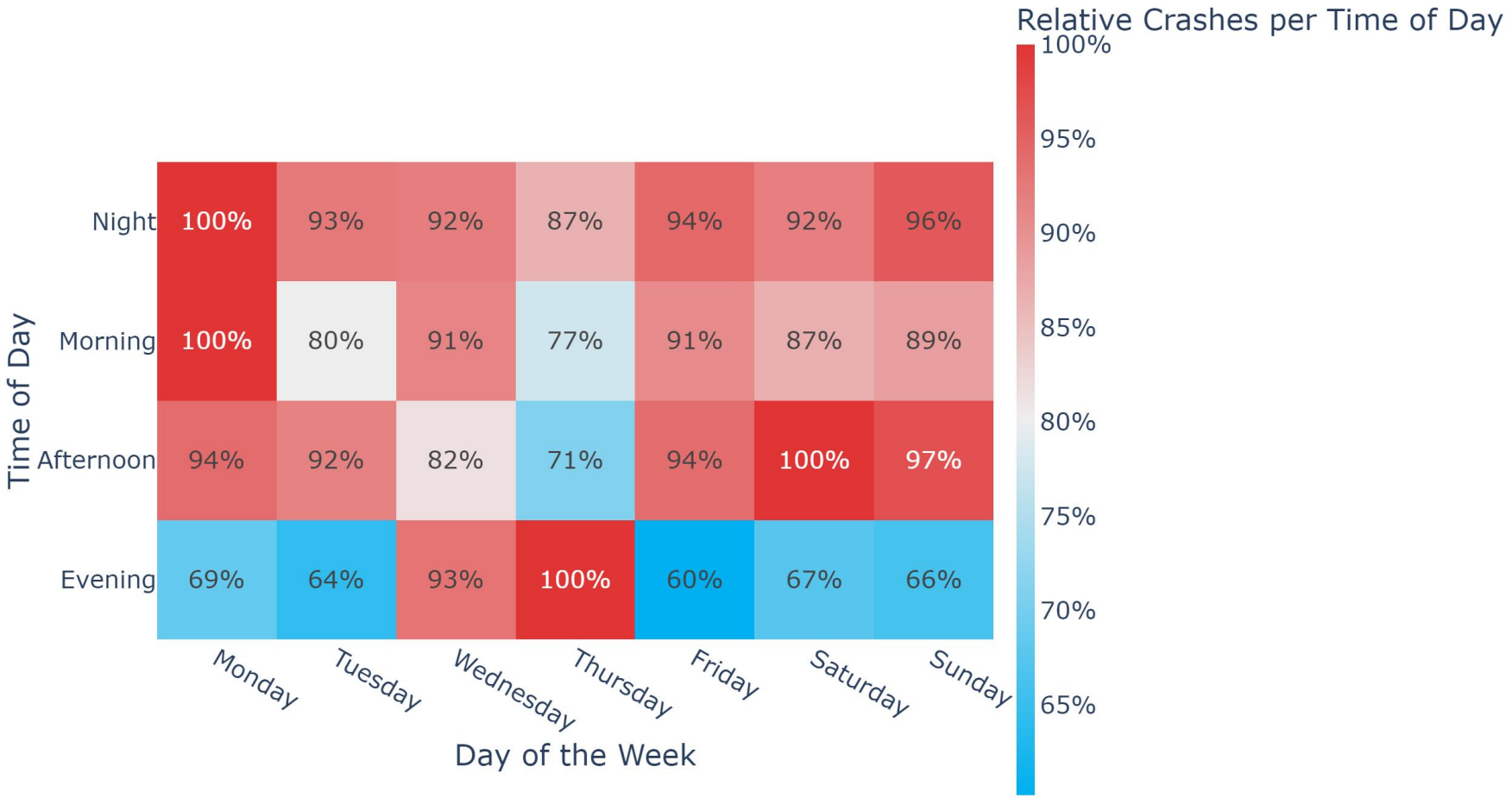
# Emergency Callouts by Part of Day



# Emergency Callouts Over Time



# Crashes by Day



# Further Cleaning

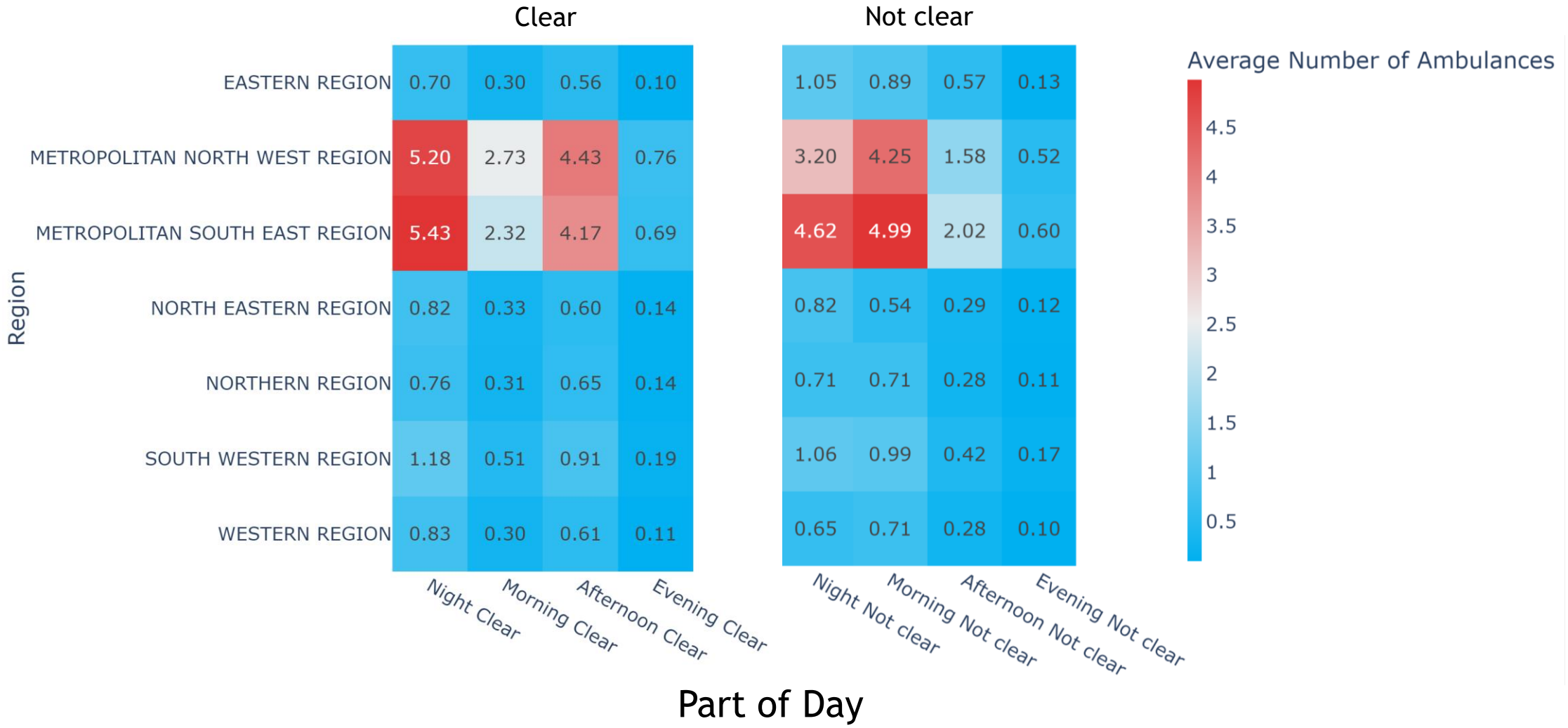
# Target Format

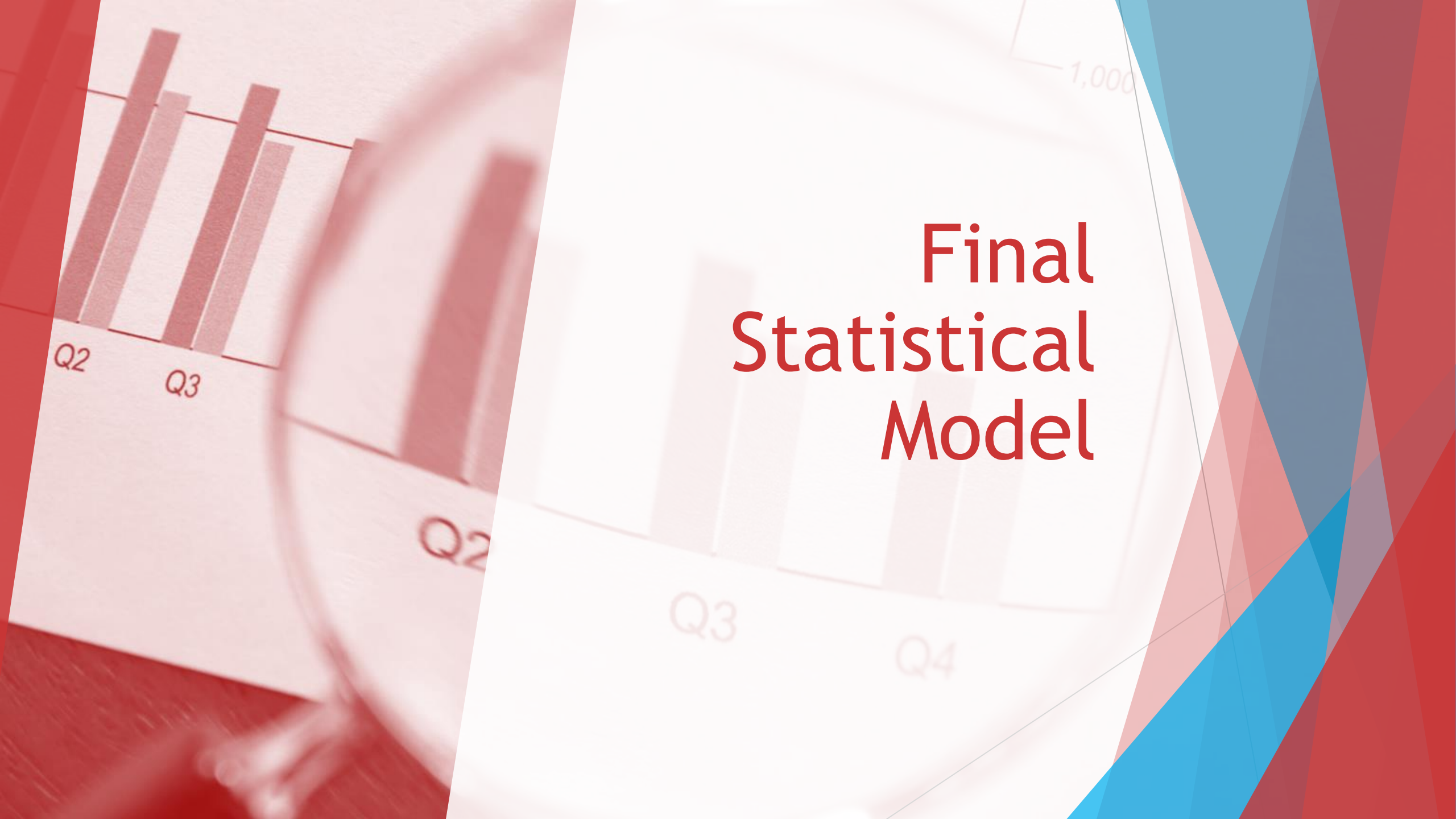
- For each combination of
  - Sky condition
  - Region
  - Day of the week
  - Part of the day
- Calculate average number of emergency services

# Potential Issues

- Regional areas have smaller number of samples
- Data is already split up into rainy days and clear days
  - Infrequent rainy days will skew data
  - Use probability of a rainy day to compensate
- Data is both summated and averaged over time

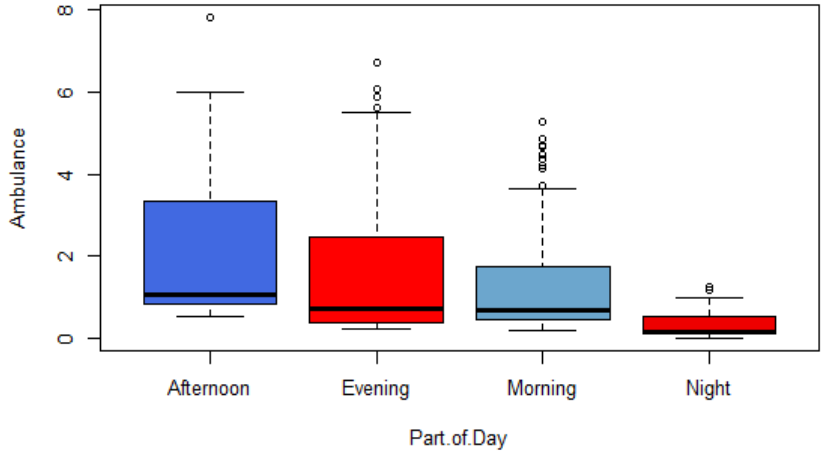
# Cleaned Data Averaged Over Days

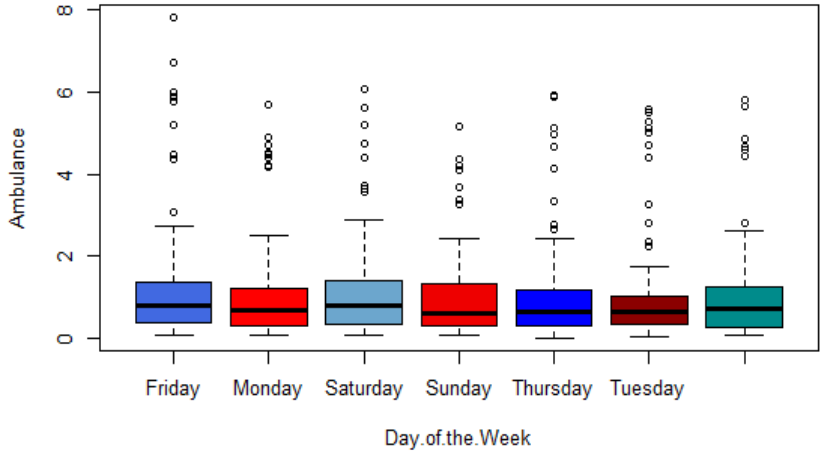


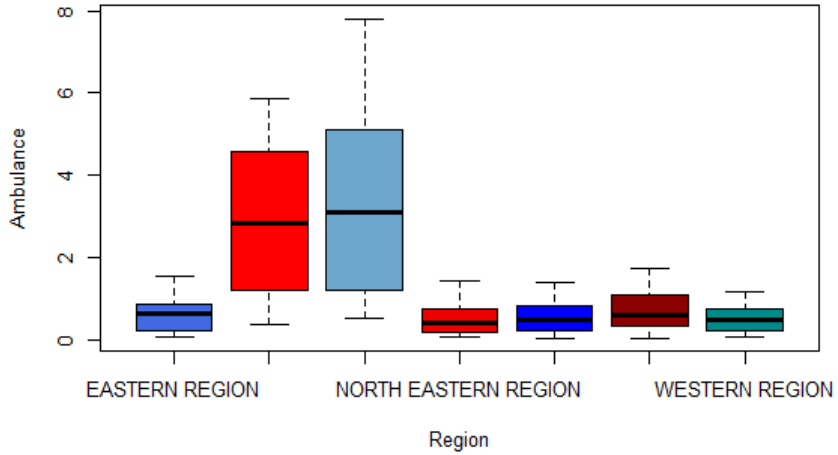


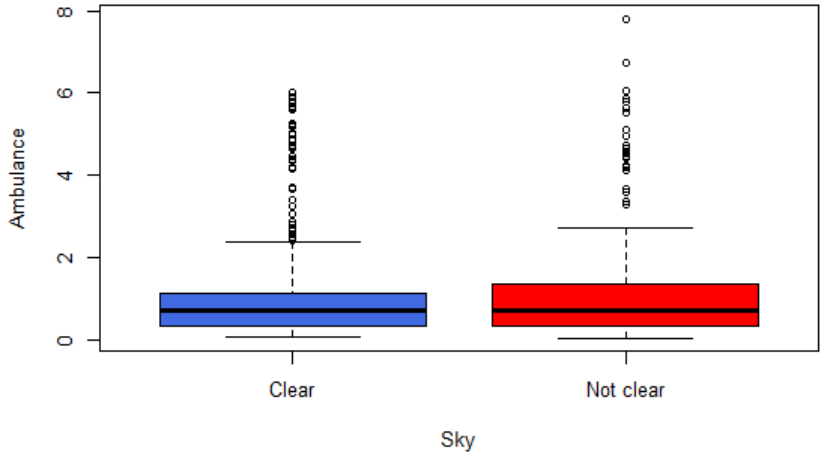

# Final Statistical Model

# Distribution of Features

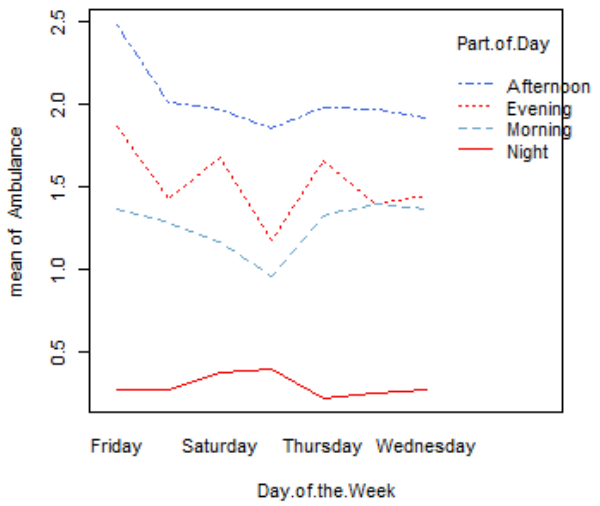


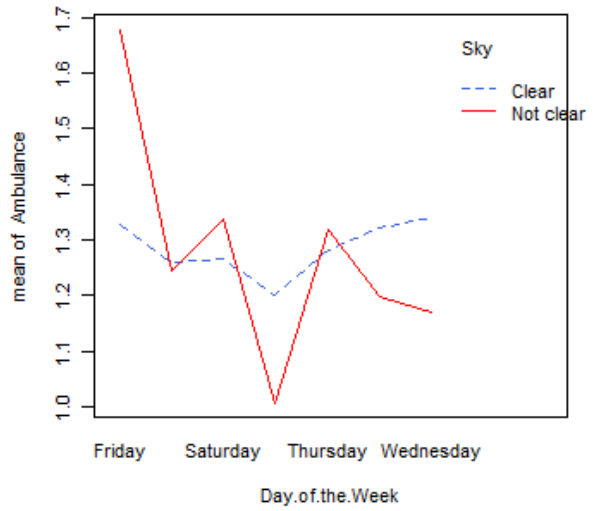



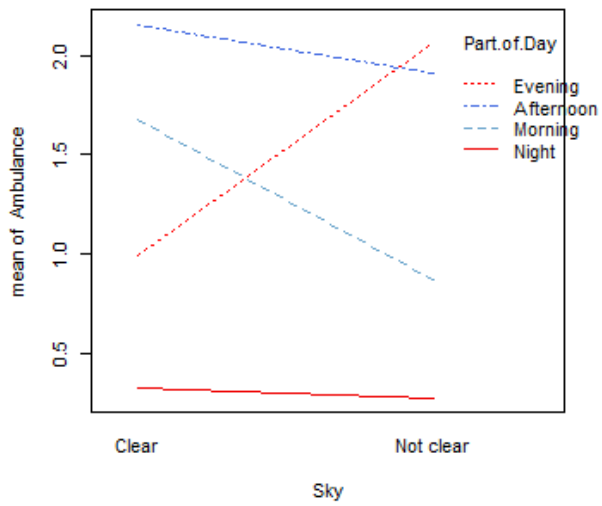



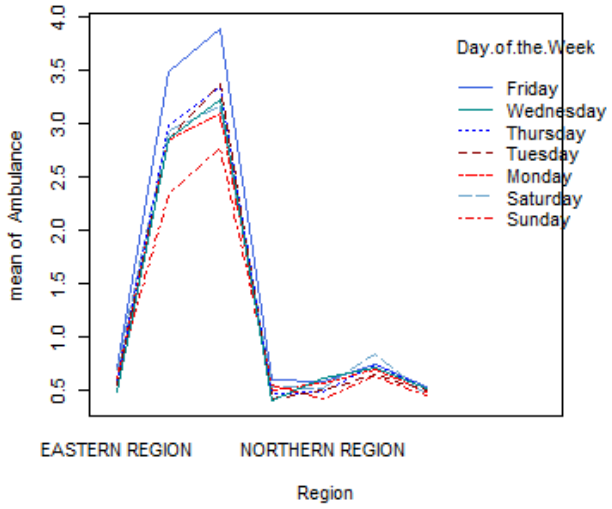



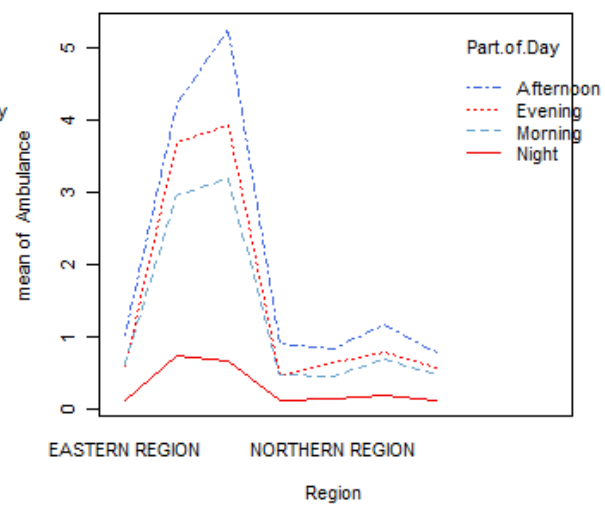
# Interaction of Features

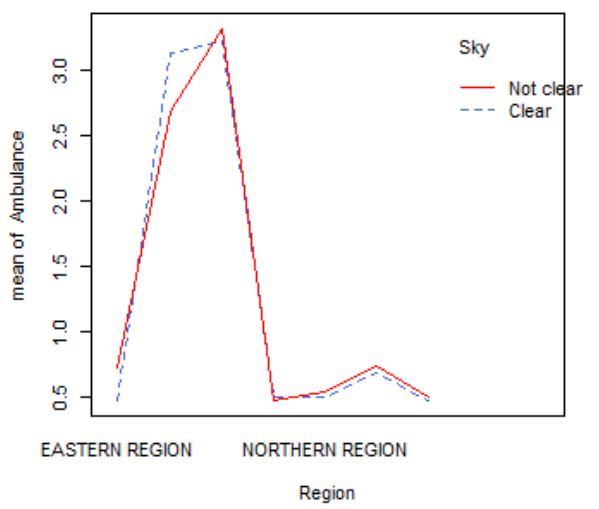


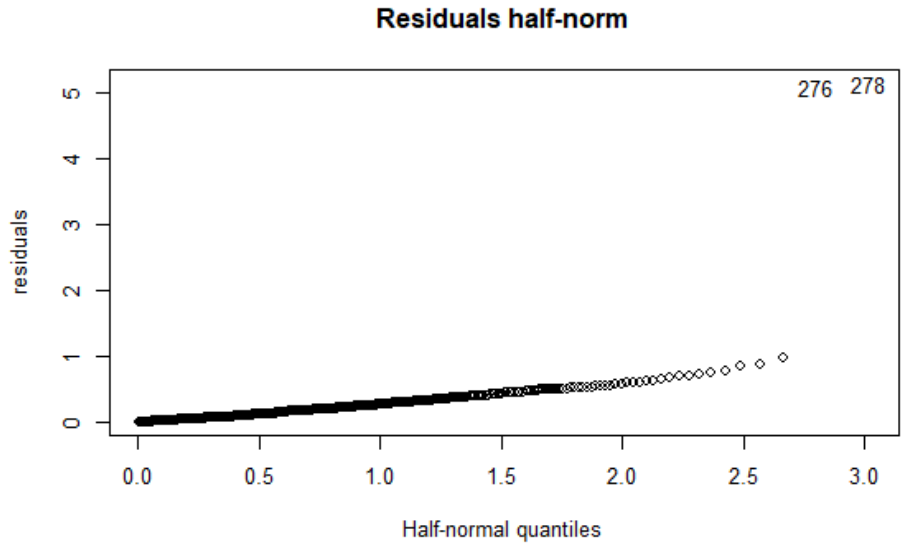



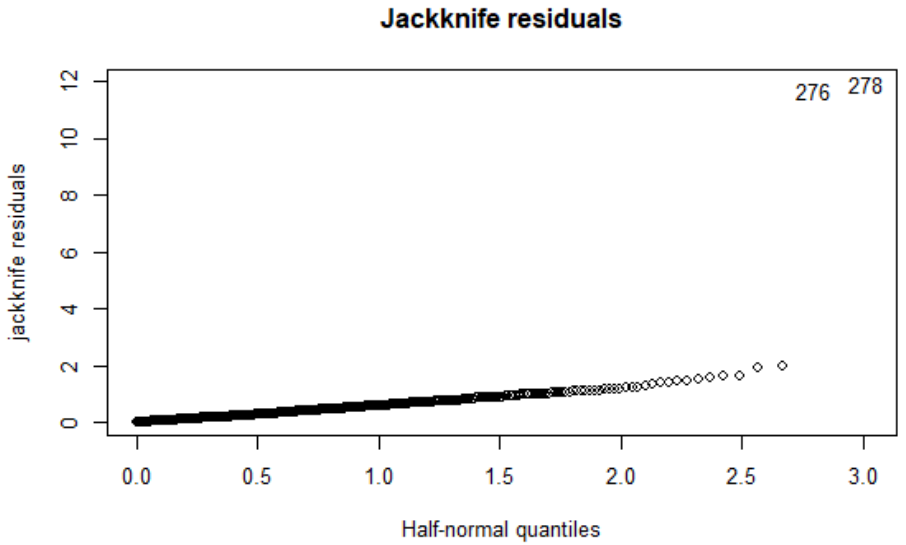



# Model of choice:
# Gamma General Linear Model (GLM)

- Statistical model allows for prediction and understanding inner workings
- Good for continuous data
- Good for data between 0 and infinity

# Oh oh! outliers!



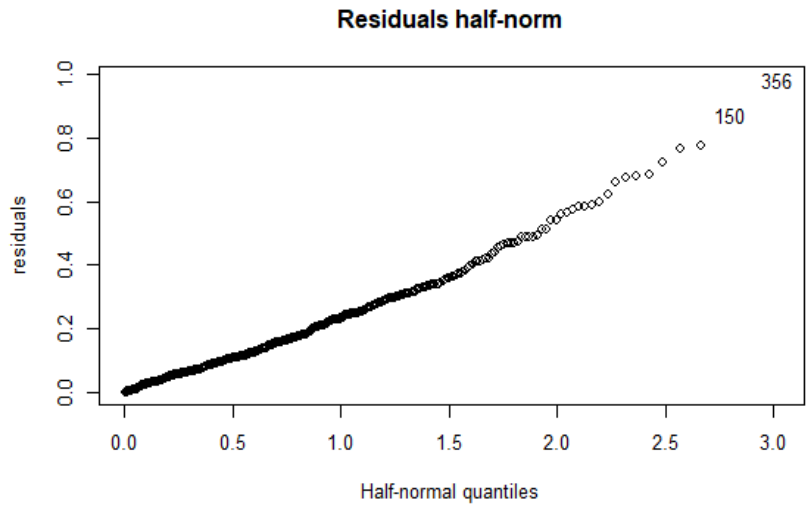
# Model Formula

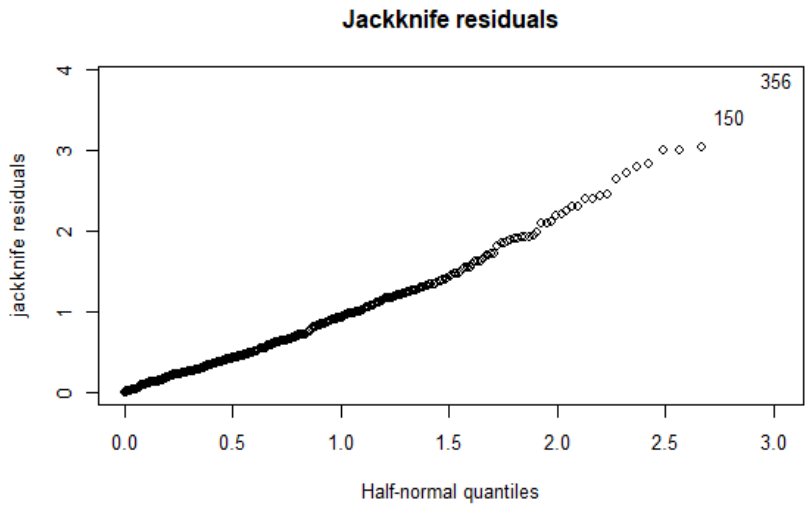
## Gamma GLM

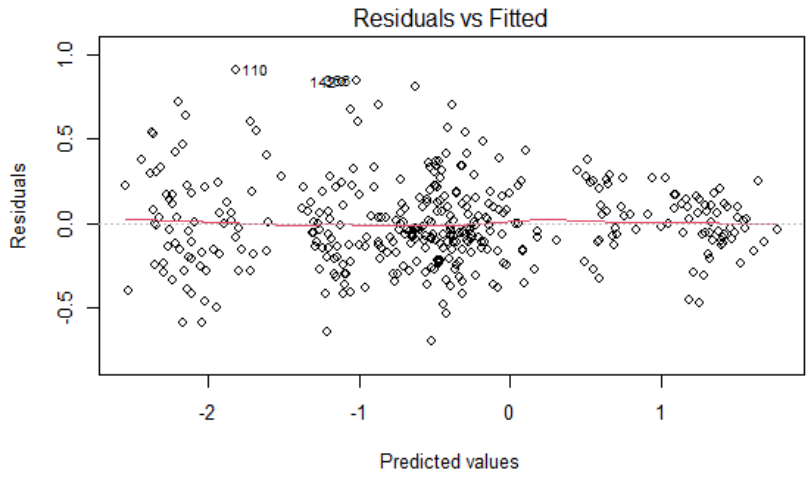
- Region
- Day of the Week
- Part of Day
- Sky condition

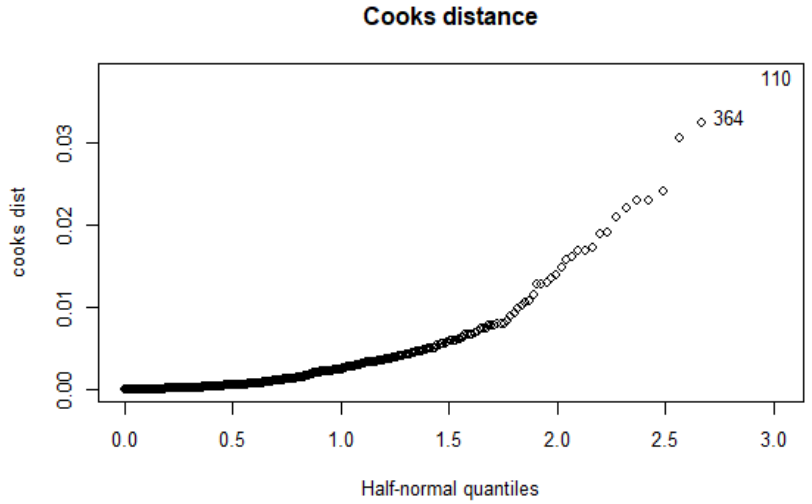
- 2-way interaction between
  - Day of the Week
  - Part of Day
  - Sky condition

# Model Diagnostic Plots



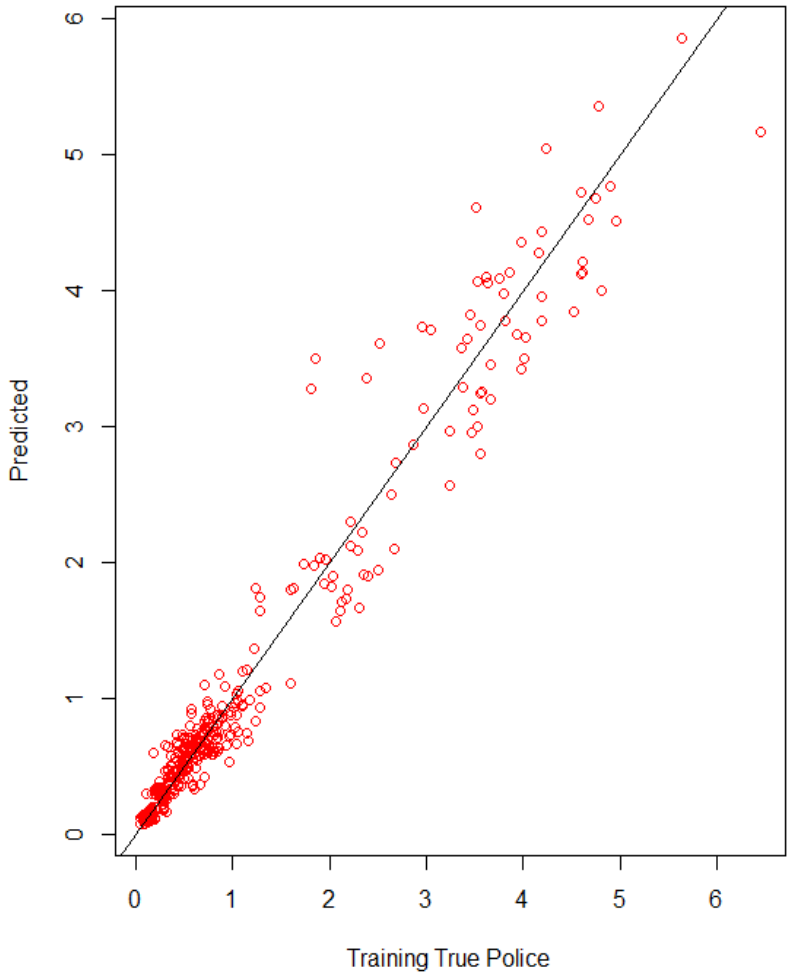



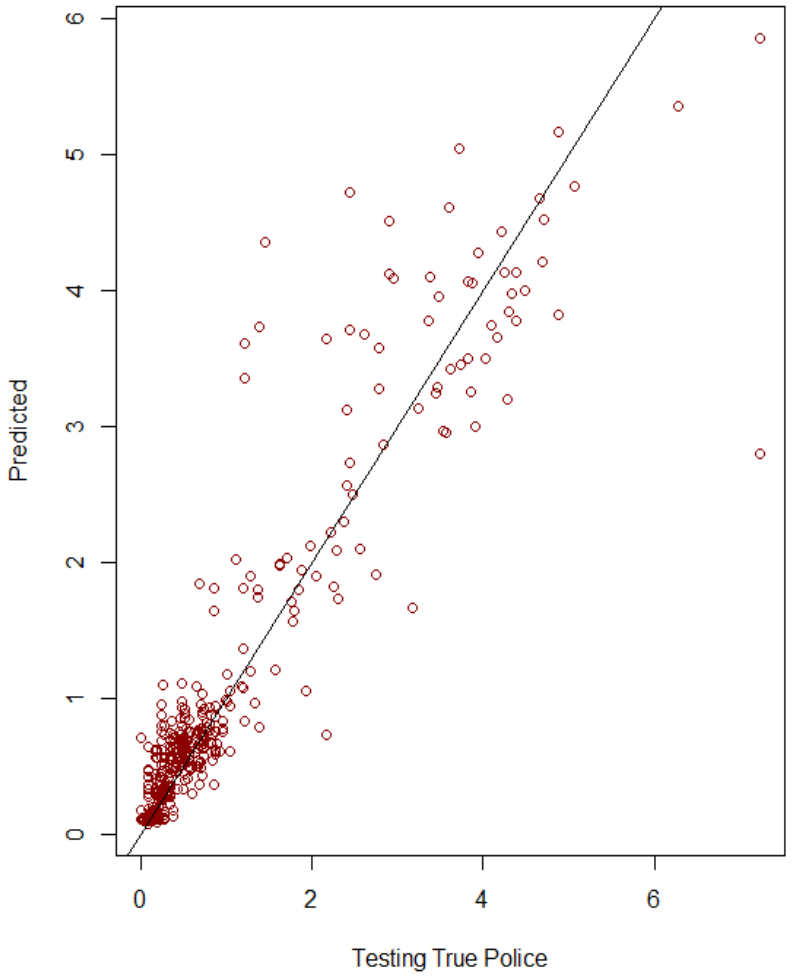



# Predicting Police Demand

## Training Data

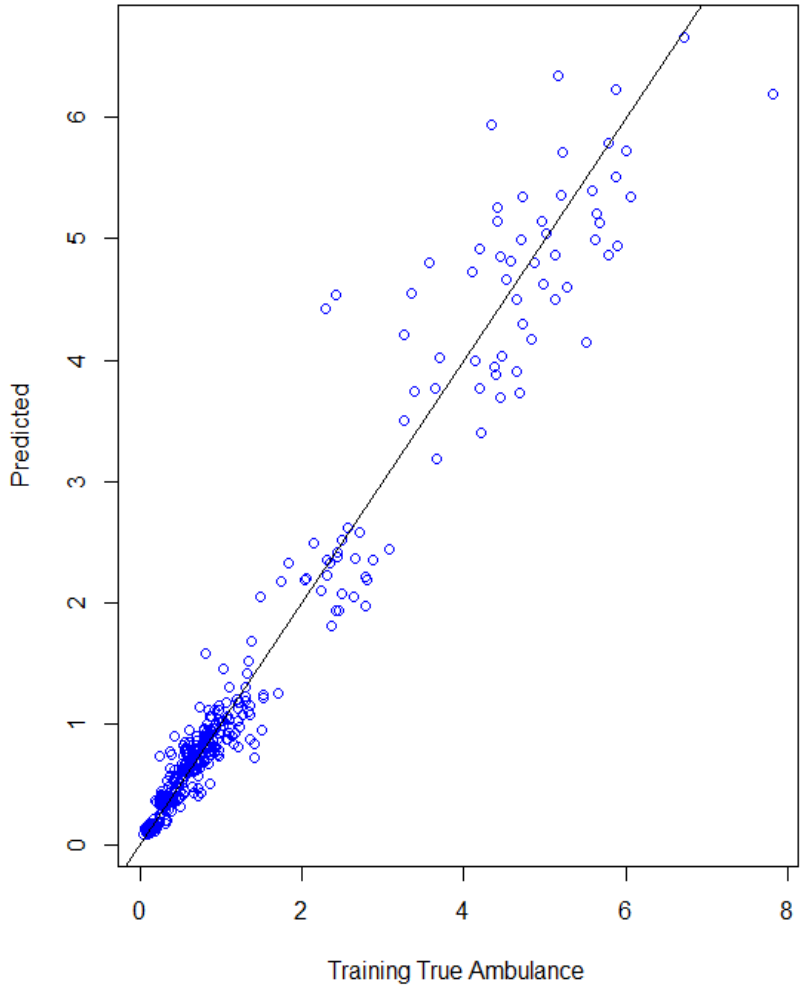



## Testing Data

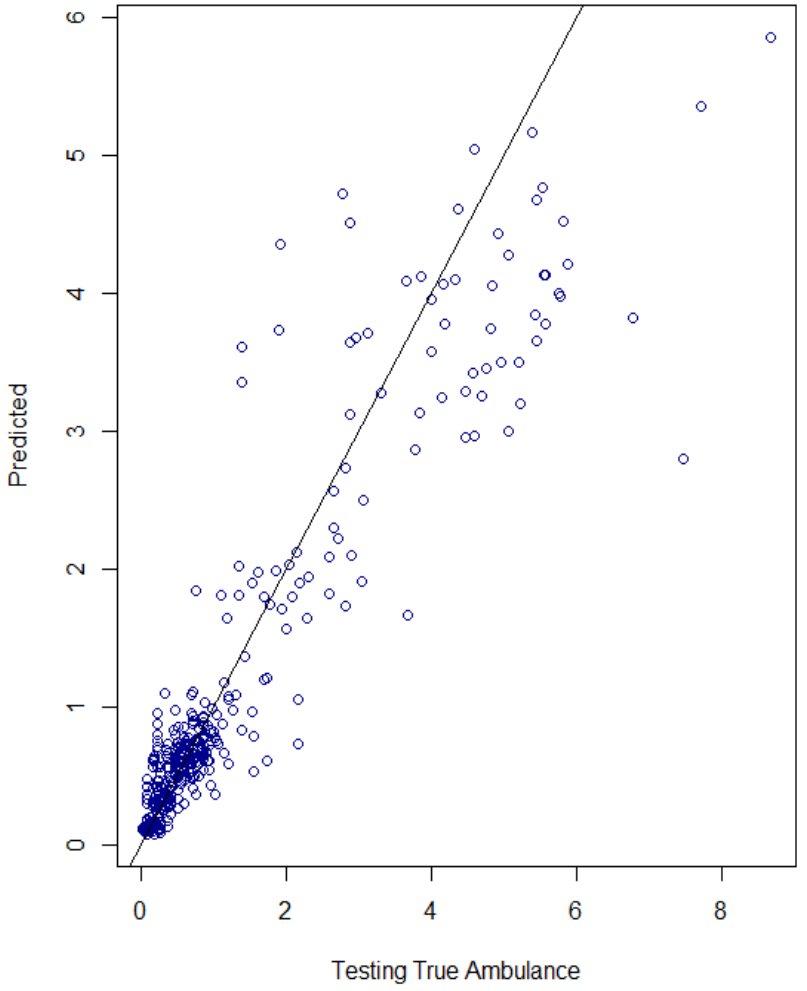


# Predicting Ambulance Demand

## Training Data




## Testing Data



# Statistical results

- Metropolitan areas greatly increase the chance of need an ambulance
- Evenings and nights decreases risk
  - Except Saturday and Sunday night
- Mornings increased risk

- Weather being not clear in the evening increased risk quite a bit
  - Whereas raining in the morning decreased risk
- Raining itself wasn’t significant

# Questions!