Predictive EMS Dispatching with Fire Dispatch Data

In a lively city like New York City, the sound of sirens are abundant. However, with so many people, cars, and traffic, how are the fire department's resources allocated by borough?

We hope that our data will be able to determine if the NYFD has effectively distributed its resources across all 5 boroughs - and outline any possible pitfalls that arise.

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Goodness

To ensure goodness in our insights, we:

- compared our data to known outcomes
- compared multiple variables to each other when possible to ensure that data was consistent
- used historic data from a reliable data source

Data Sources

Source: NYC OpenData

Fire Incident Dispatch Data

The Fire Incident Dispatch Data file contains data that is generated by NYC's Starfire Computer Aided Dispatch System.

2.62 GB, 8.69M Rows, 29 columns

https://data.cityofnewyork.us/Public-Safety/EMS-Incident-Dispatch-Data/76xm-jjuj

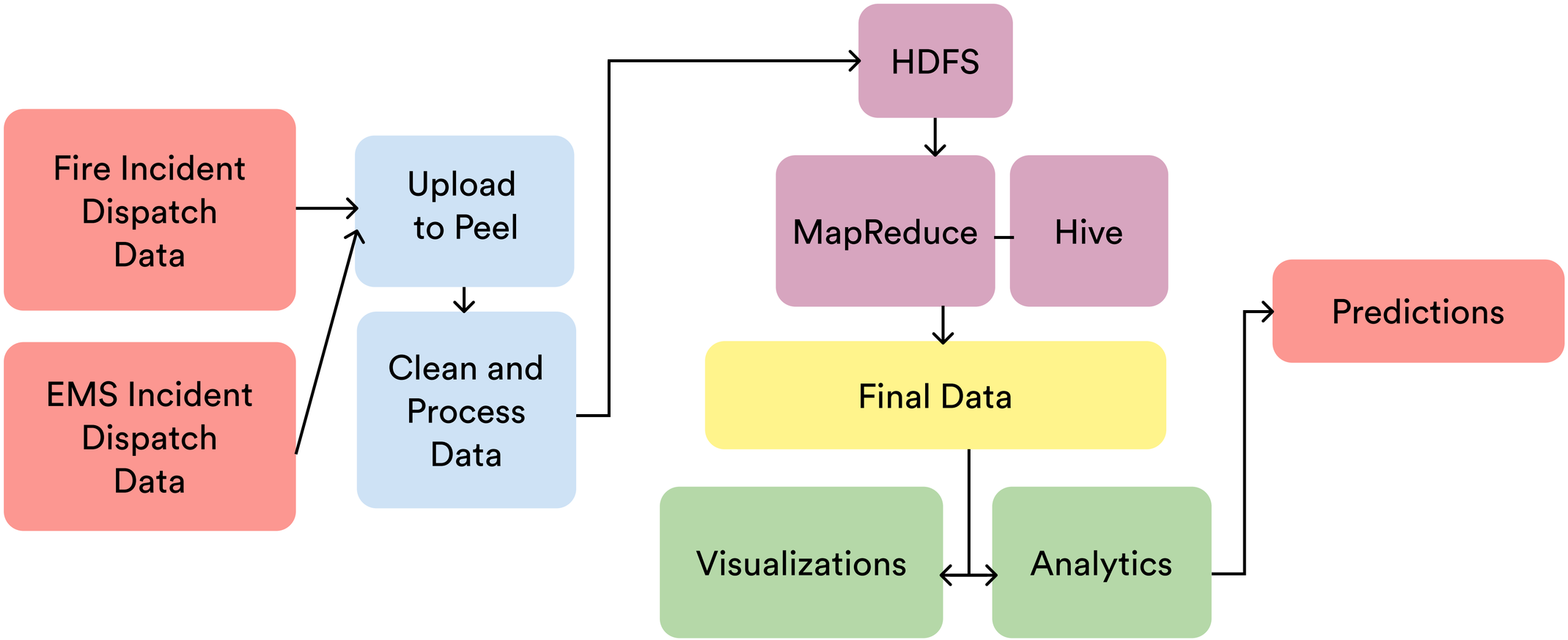
EMS Incident Dispatch Data

The EMS Incident Dispatch Data file contains data that is generated by NYC's EMS Computer Aided Dispatch System.

5.61 GB, 23.2M Rows, 31 columns

https://data.cityofnewyork.us/Public-Safety/Fire-Incident-Dispatch-Data/8m42-w767

Design Diagram



Code Challenge

```java
public class AnalyticsMapper extends Mapper<Object, Text, Tex

    public void map(Object key, Text value, Context context)
        String line = value.toString();
        String[] values = line.split(regex: ",");
        try{
            String severity_code = values[2];
            String incident_response = values[4];
            int test = Integer.parseInt(severity_code);
            int test2 = Integer.parseInt(incident_response);
            String borough = values[6];
            String count = "1";
            context.write(new Text(borough), new Text(severit
        }
        catch(Exception ex){
        }
    }
}
```

```java
public class Analytics {
    Run | Debug
    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        conf.set("mapreduce.output.textoutputformat.separator", ",");
        Job job = Job.getInstance(conf, "Data Analytics");
        job.setNumReduceTasks(1);
        job.setJarByClass(Analytics.class);
        job.setMapperClass(AnalyticsMapper.class);
        job.setCombinerClass(AnalyticsReducer.class);
        job.setReducerClass(AnalyticsReducer.class);
        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(Text.class);
        FileInputFormat.addInputPath(job, new Path(args[0]));
        FileOutputFormat.setOutputPath(job, new Path(args[1]));
        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }
}
```

```java
14  public class AnalyticsReducer extends Reducer<Text,Text,Text,Text>
15
16      public void reduce(Text key, Iterable<Text> values, Context co
17
18          double count = 0;
19          double severitySum = 0;
20          double responseSum = 0;
21          double sum = 0;
22
23          for (Text val : values){
24              String line = val.toString();
25              String[] word = line.split(regex: ",");
26              double severity_code = Double.parseDouble(word[0]);
27              double incident_response = Double.parseDouble(word[1]);
28              count = Double.parseDouble(word[2]);
29              severitySum += severity_code;
30              responseSum += incident_response;
31              sum+=count;
32          }
33          context.write(key, new Text(String.valueOf(severitySum) + '
34      }
}
```

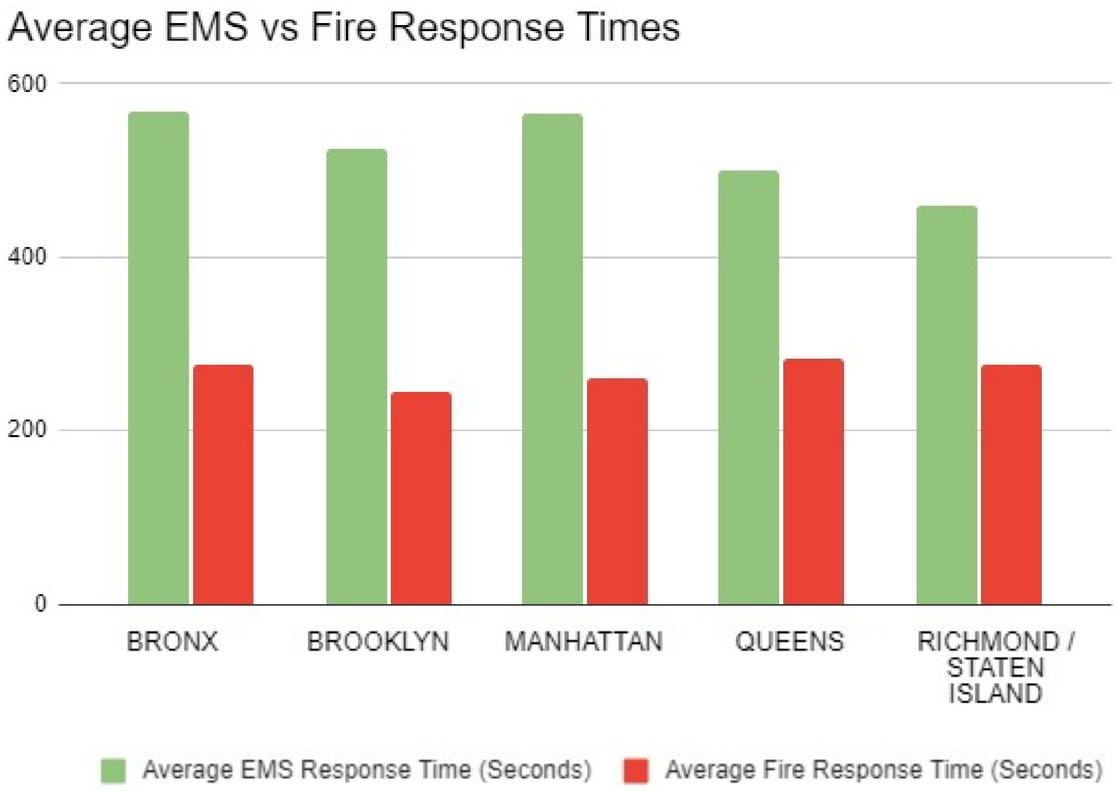
Problems

- Key with multiple values
- Couldn't calculate the averages with the reducer
- Issues with uploading data to Hive tables

Solutions

- Converted the values to String as comma separated values as a value
- Stored the total sums of data instead and the counts, calculated averages in Excel
- Changed key-value pair separator to a comma instead of a blank space in the main method

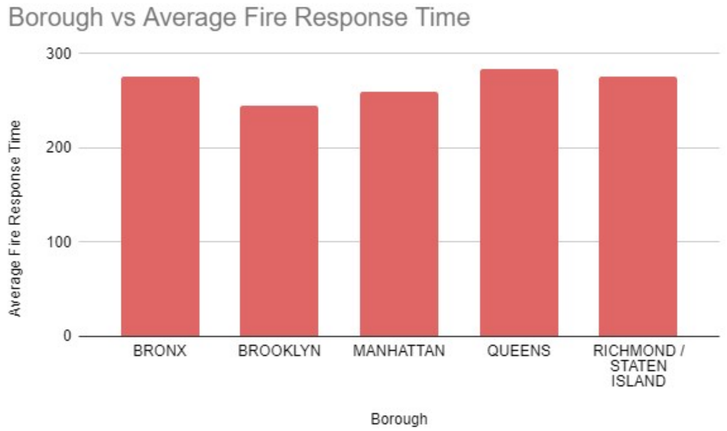
Insight

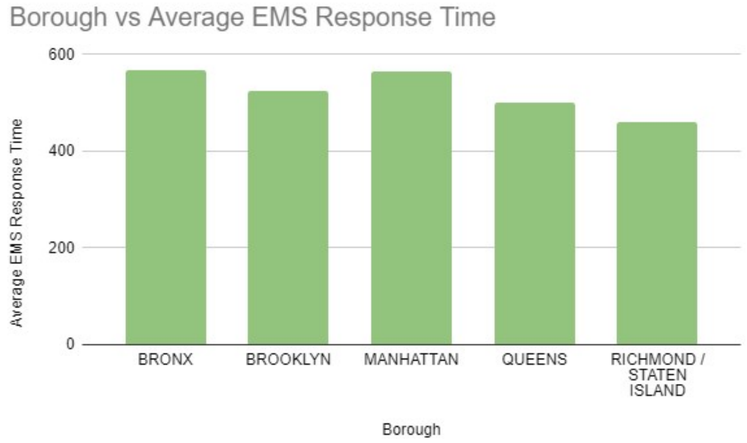


Fire response times are significantly faster than EMS response times. Why?

- Fire trucks have priority over ambulances in traffic
- In a fire there are more lives at risk when compared to 1/2 people in an ambulance

Insight





For Fire Response Time:

- Queens -> Staten Island -> Bronx -> Manhattan -> Brooklyn

Difference between fastest and slowest: 39s

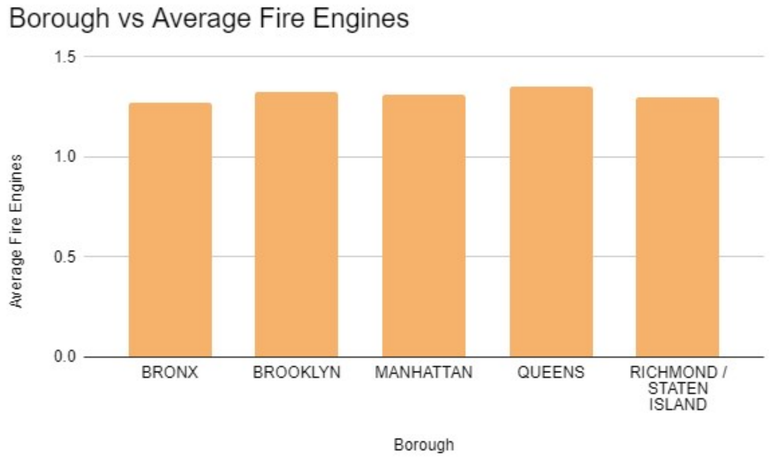
For EMS Response Time:

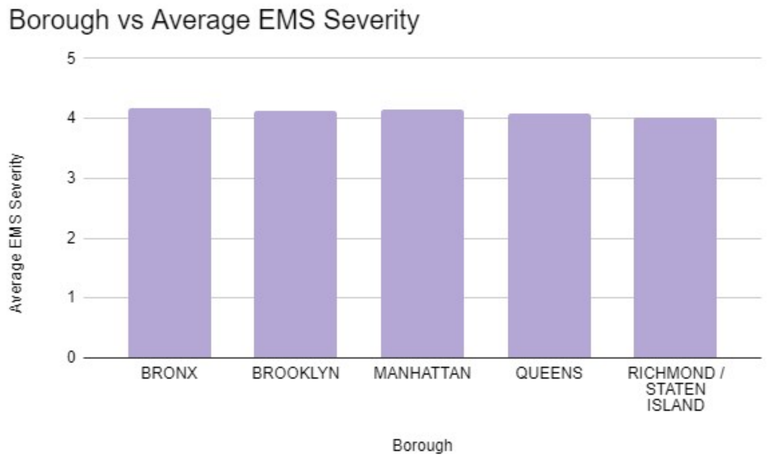
- Bronx -> Manhattan -> Brooklyn -> Queens -> Staten Island

Difference between fastest and slowest: 108s

- Larger spread in average times for EMS when compared to fire department
- No clear pattern between boroughs and fire departments and EMS, some boroughs are good for one and some for the other

Insight





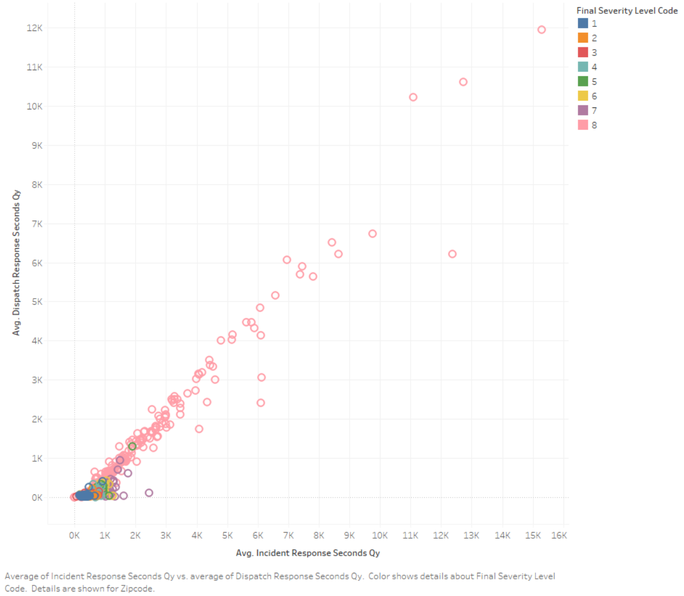
Average fire engine dispatched does not vary too much from borough to borough

- We used this as a measure of how severe fires were, if more engines dispatched, more severe

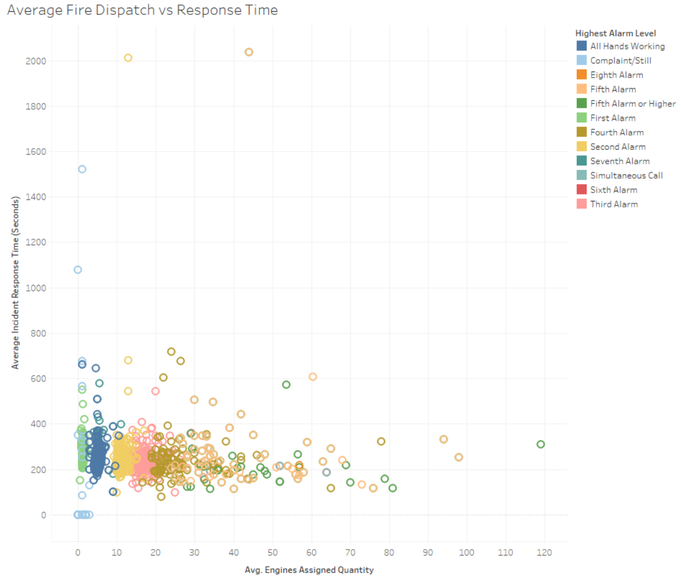
Average EMS severity is pretty consistent throughout boroughs

- We checked this to see if it was possible to improve EMS resource allocation by allocating more resources to boroughs with an average higher severity

Insight



Average of Incident Response Seconds Qy vs. average of Dispatch Response Seconds Qy. Color shows details about Final Severity Level Code. Details are shown for Zipcode.



Average of Engines Assigned Quantity vs. average of Incident Response Seconds Qy. Color shows details about Highest Alarm Level. Details are shown for Zipcode.

- As severity increases, it actually takes longer for EMS respond and dispatch

- As alarm level increases, more engines are deployed
- Response time remains similar despite alarm level

Acknowledgements

References

https://data.cityofnewyork.us/Public-Safety/EMS-Incident-Dispatch-Data/76xm-jjuj

https://data.cityofnewyork.us/Public-Safety/Fire-Incident-Dispatch-Data/8m42-w767

Appendix

ems.borough	ems.severity	ems.incident_respons	ems.count	fire.borough	fire.fire_response	fire.engine	fire.count
BRONX	20458352	2790672748	4910519	BRONX	329472916	1521943	1194466
BROOKLYN	25046466	3181986253	6065180	BROOKLYN	416834012	2263196	1705105
MANHATTAN	21451406	2930886964	5185151	MANHATTAN	409399852	2068581	1577057
QUEENS	16783749	2062647059	4114709	QUEENS	340296952	1625447	1200833
RICHMOND / STATEN ISLAND	3520723	403369519	876200	RICHMOND / STATEN ISLAND	84057181	395901	304734

ems.borough	ems.severity_avg	ems.incident_respons	fire.borough	fire.fire_response_avg	fire.engine_avg
BRONX	4.166230087	568.3050504	BRONX	275.8328123	1.274161843
BROOKLYN	4.129550318	524.6317921	BROOKLYN	244.4623715	1.327305943
MANHATTAN	4.137084147	565.2462125	MANHATTAN	259.5973716	1.311671677
QUEENS	4.078963786	501.2862535	QUEENS	283.3840776	1.353599543
RICHMOND / STATEN ISLAND	4.018172792	460.3623819	RICHMOND / ST	275.8378816	1.299169111