November 2022

Delivery driver location optimization with Causal Inference

ML Project

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Outline

01

Business Objectives

02

EDA

03

Implementation

04

Conclusion and Future plan

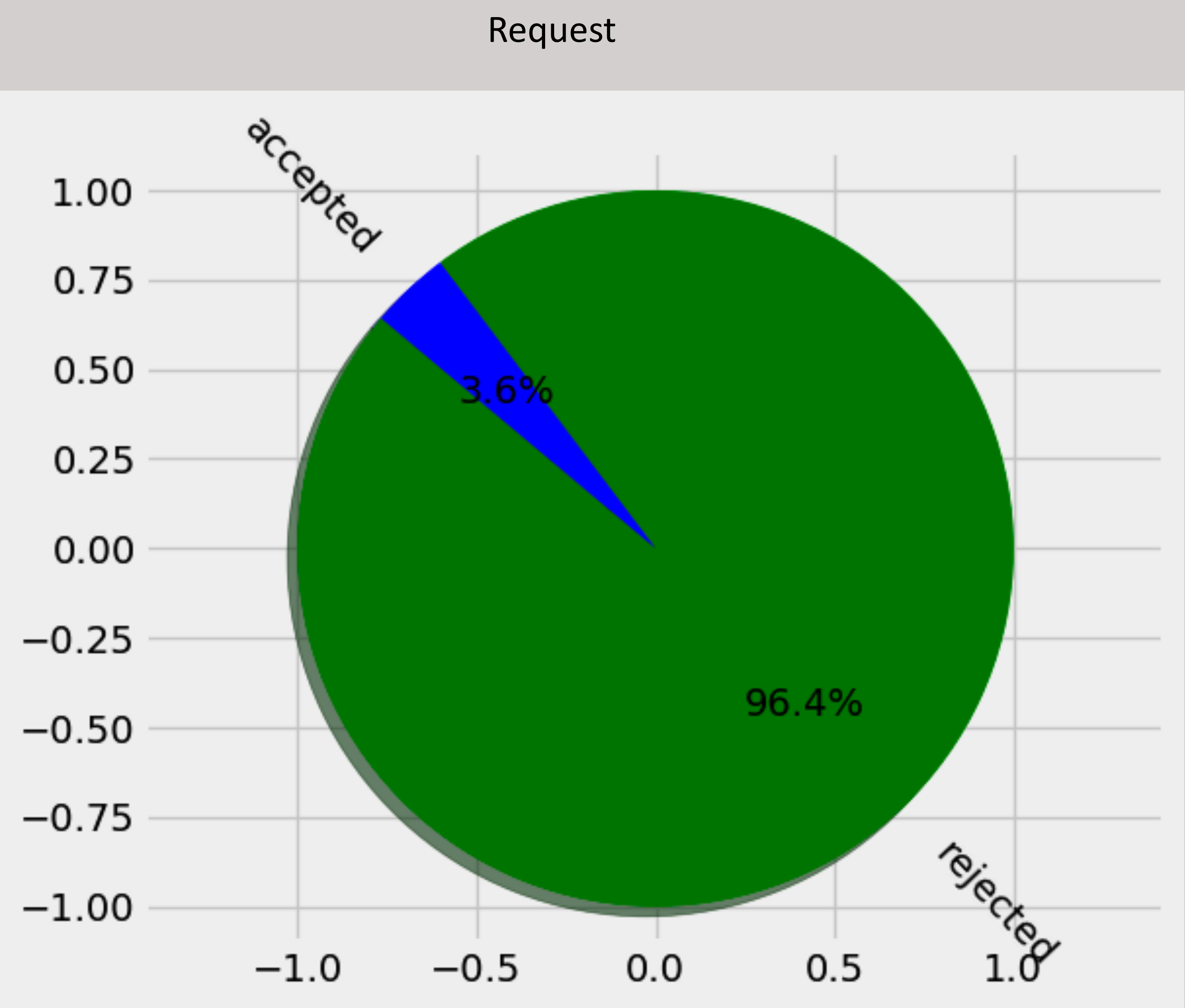
Business objective

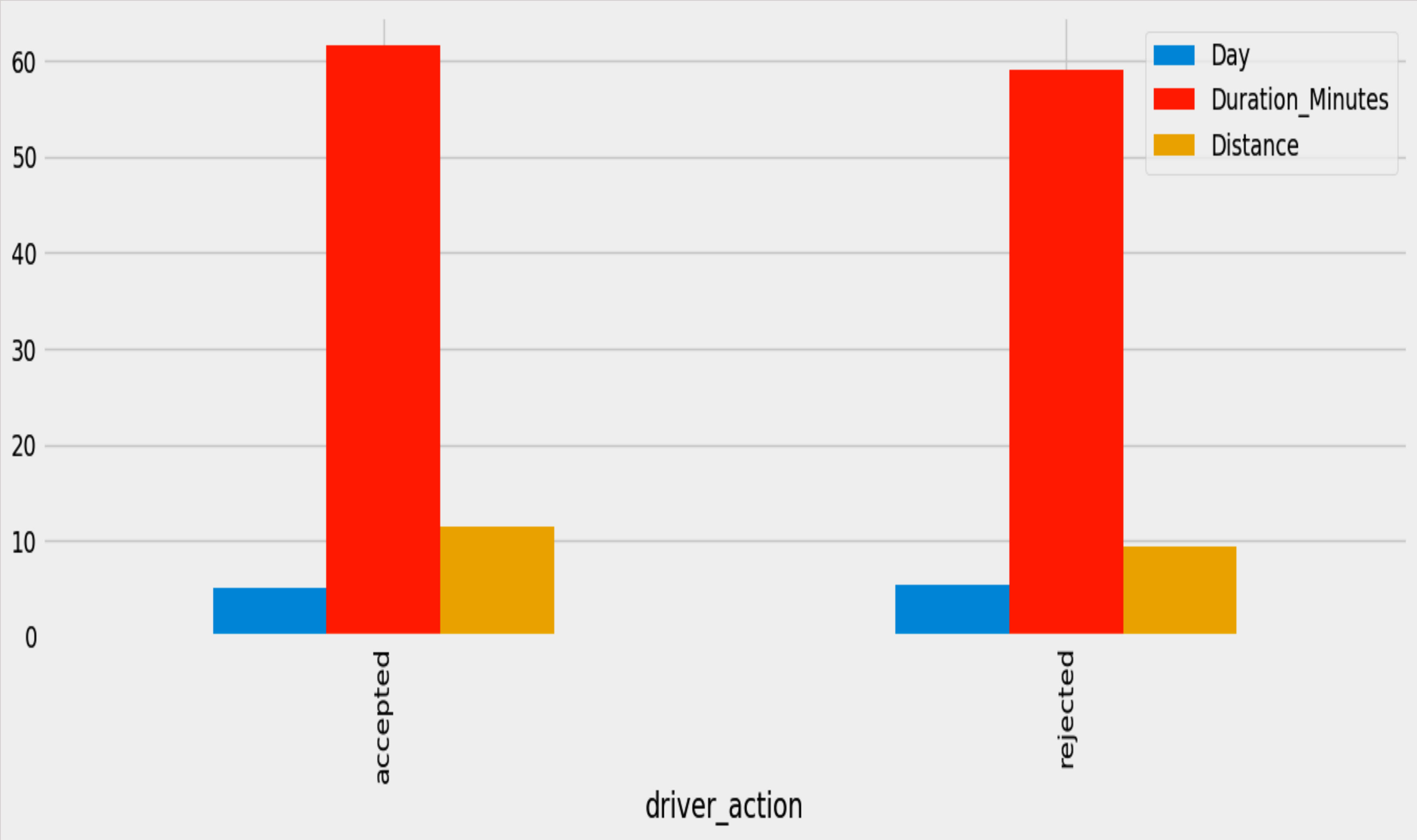
- customers wish to utilize Gokada to ship their parcels
- The inefficient positioning of drivers
- This has caused many delivery orders to be unmet.

Business objective

- Understand the primary causes of unfulfilled requests
- come up with solutions
- recommend drivers locations that increase the fraction of complete orders

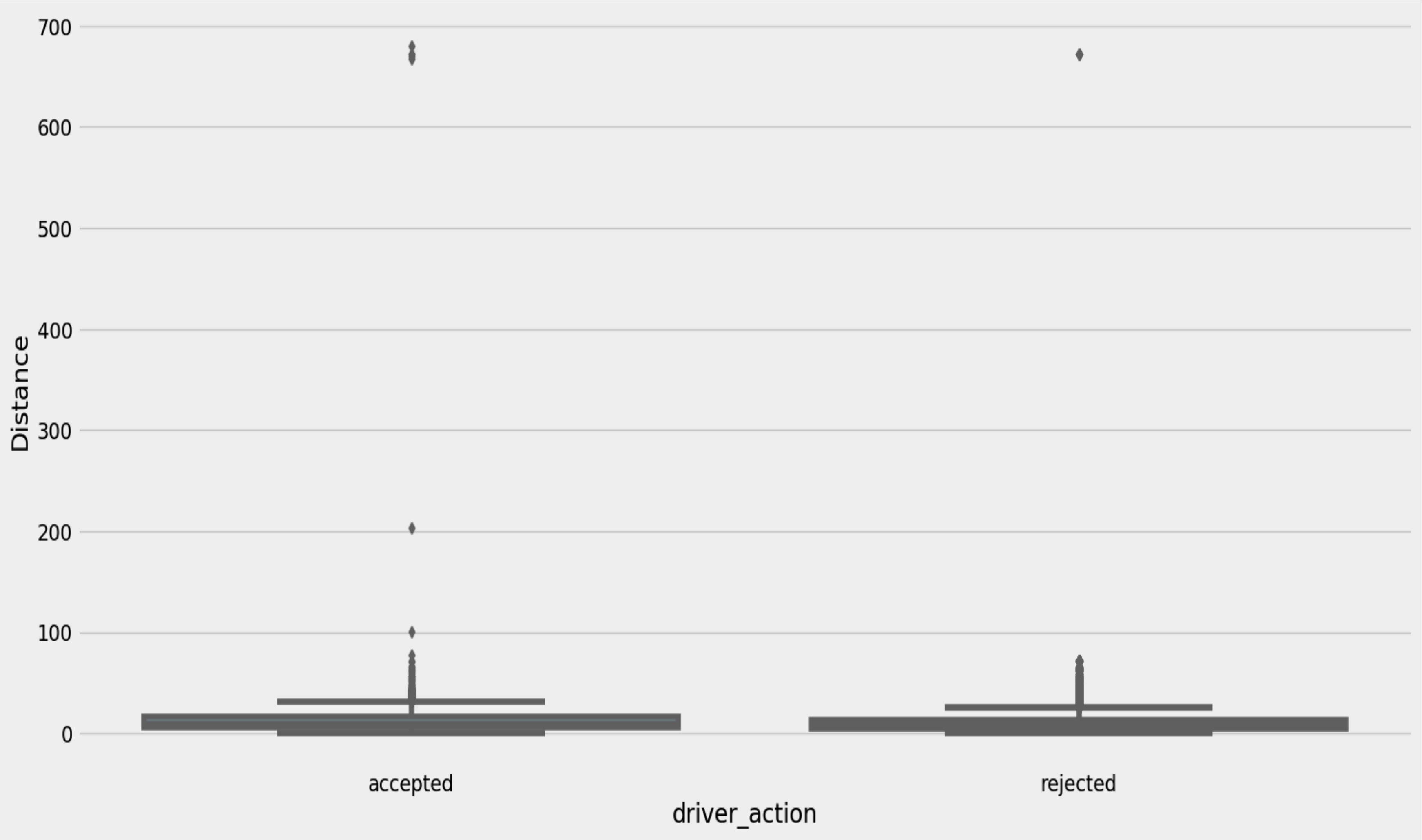
Exploratory Data Analysis

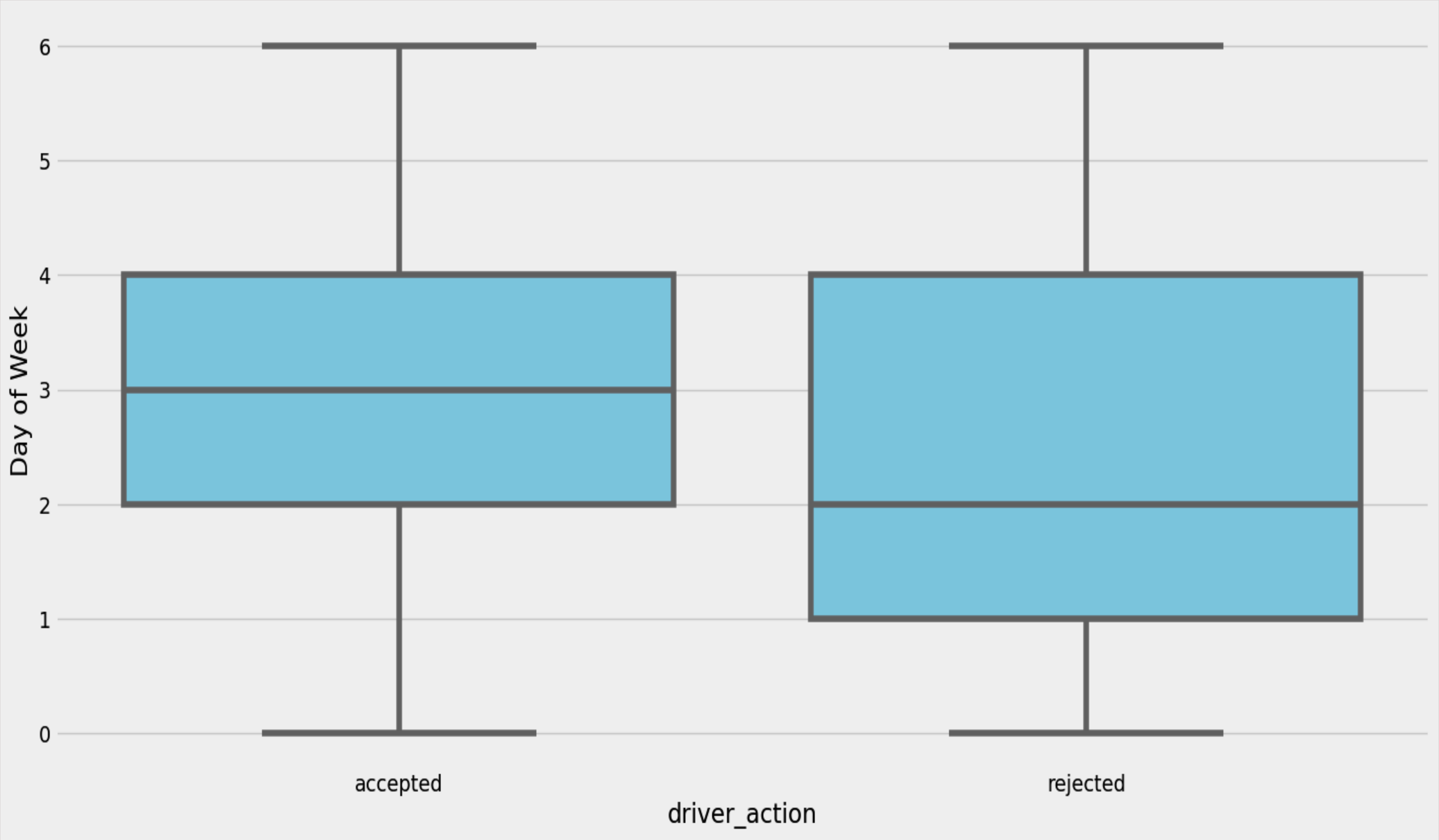




Action of the drivers given the distance average plot shows that distance doesn't really have a big difference between the rejection and acceptance.

Exploratory Data Analysis

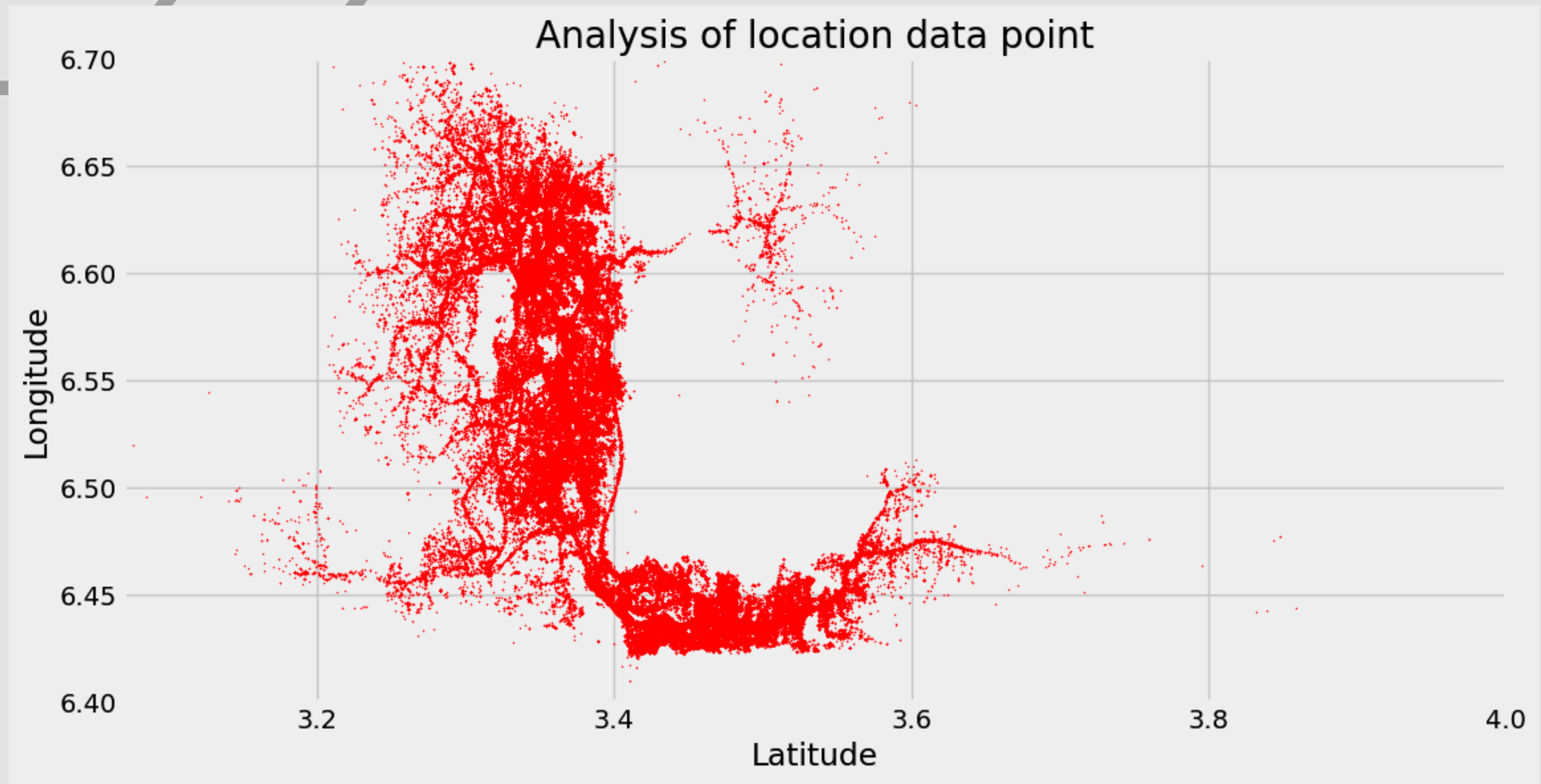


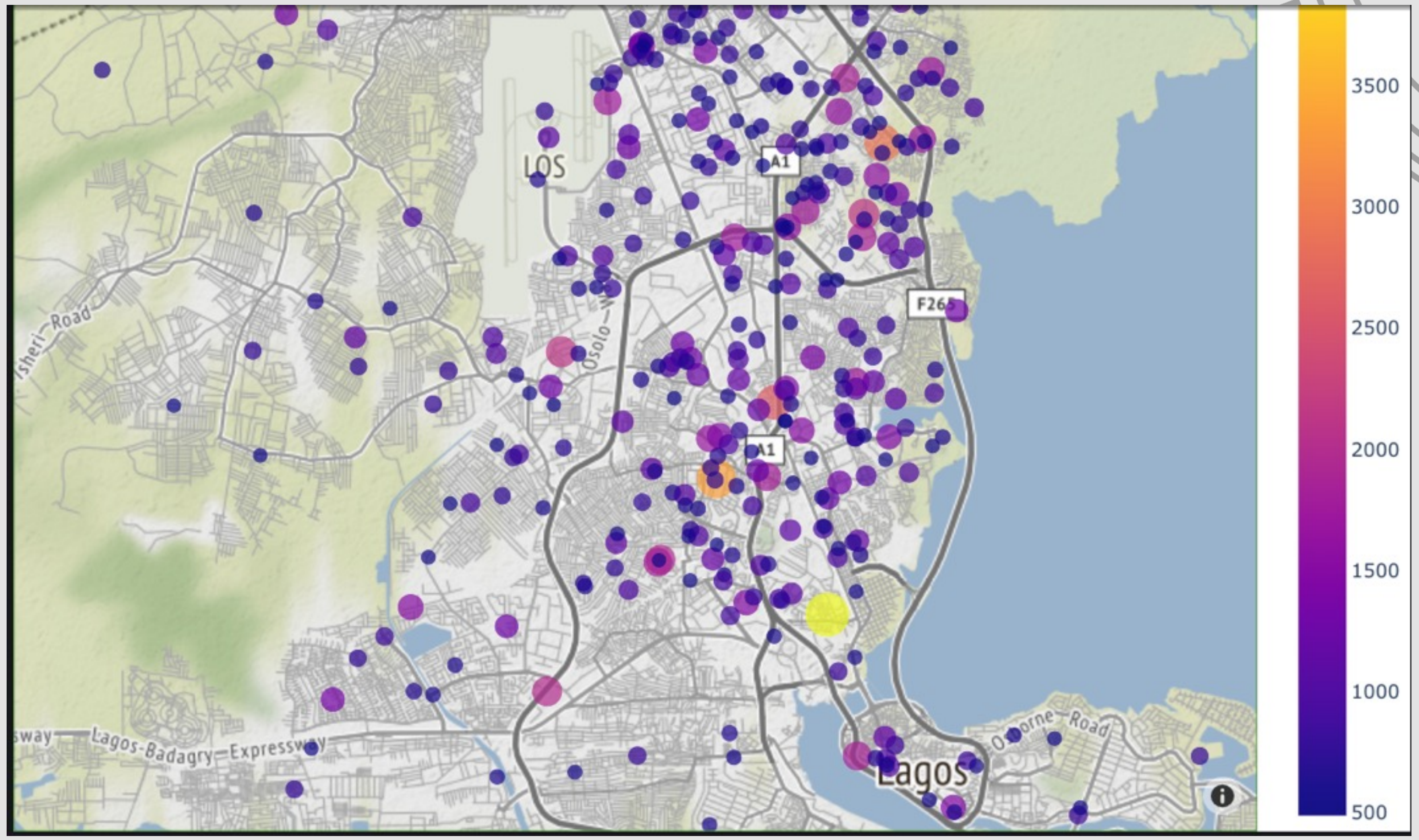


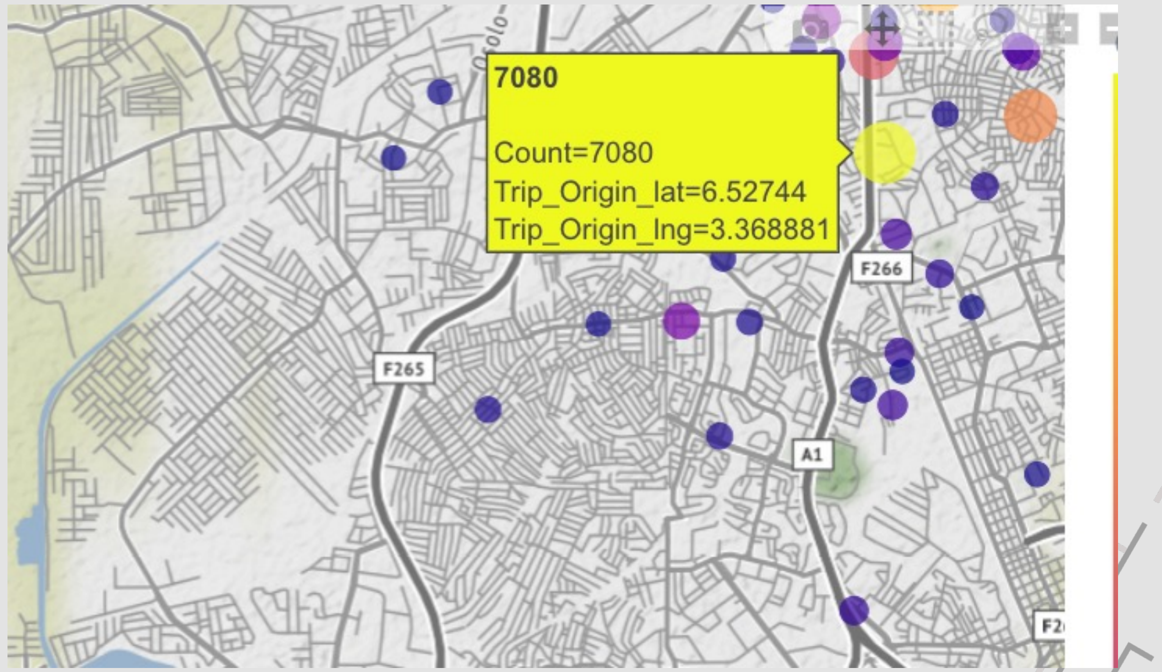
Outliers detection.

Exploratory Data Analysis

Performed Spatial Analysis on Demand given the coordinate

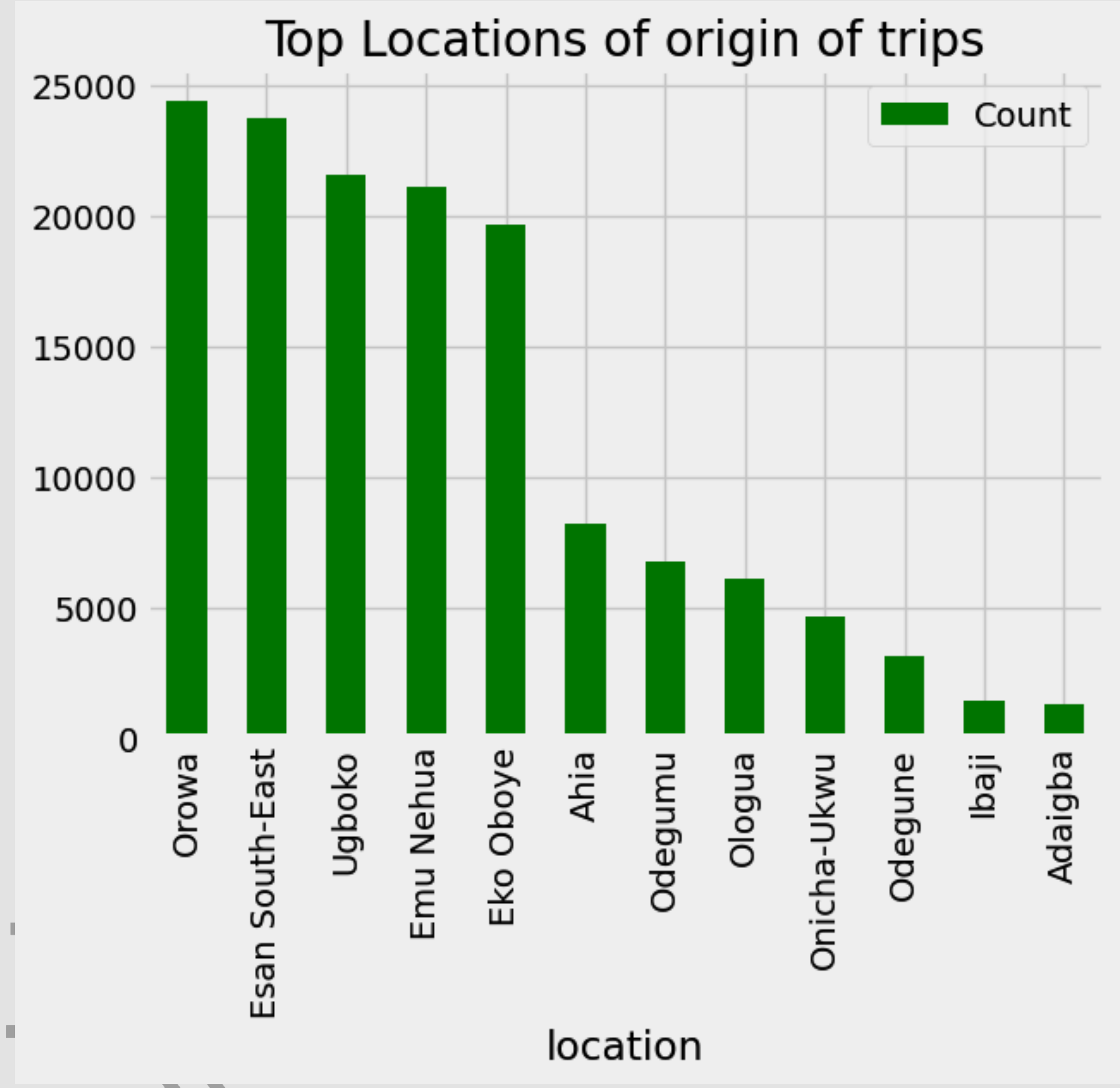


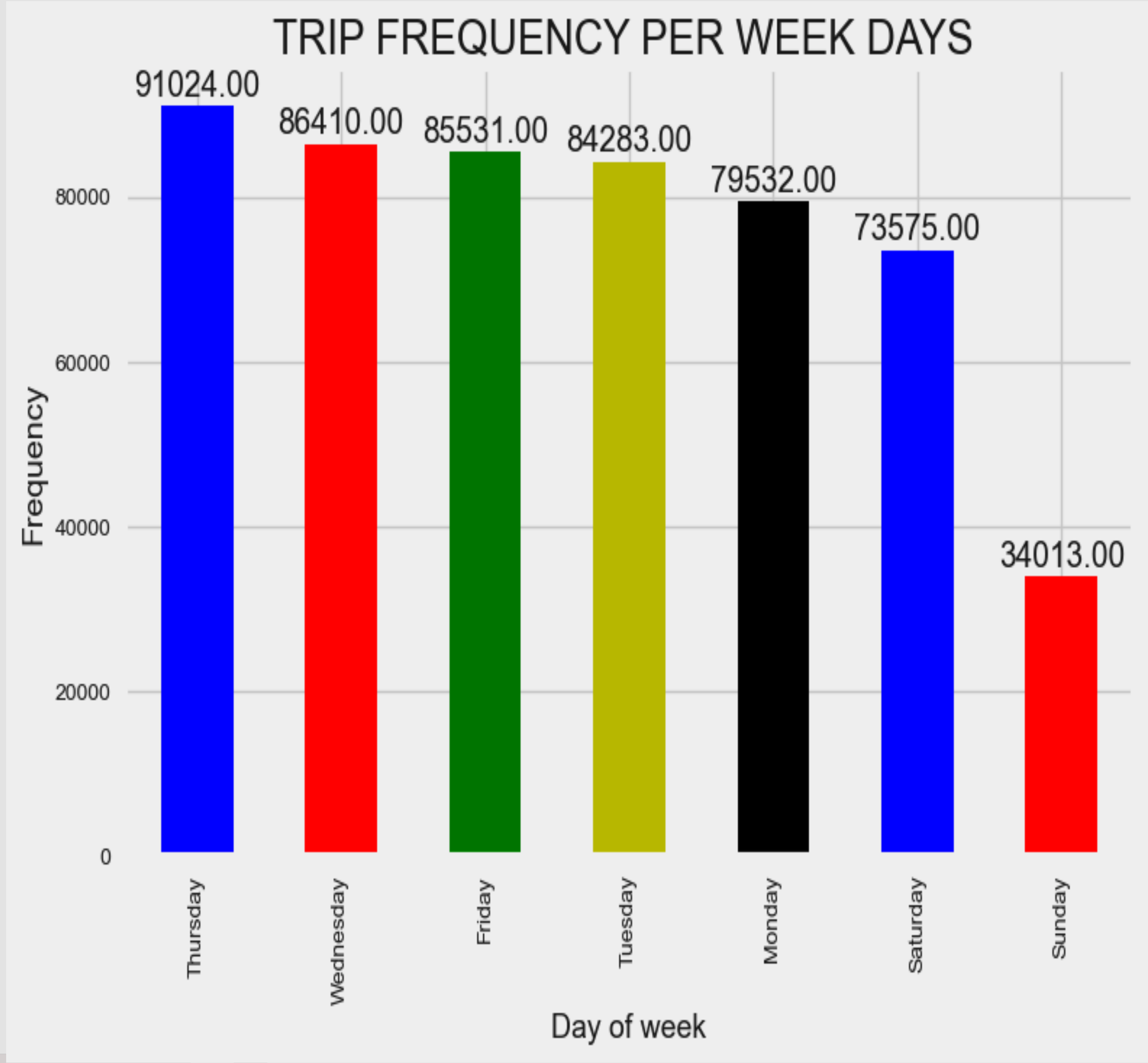




Analysis of location data point most orders are between 3.2 to 3.6 latitude and 6.43 to 6.70 of longitude

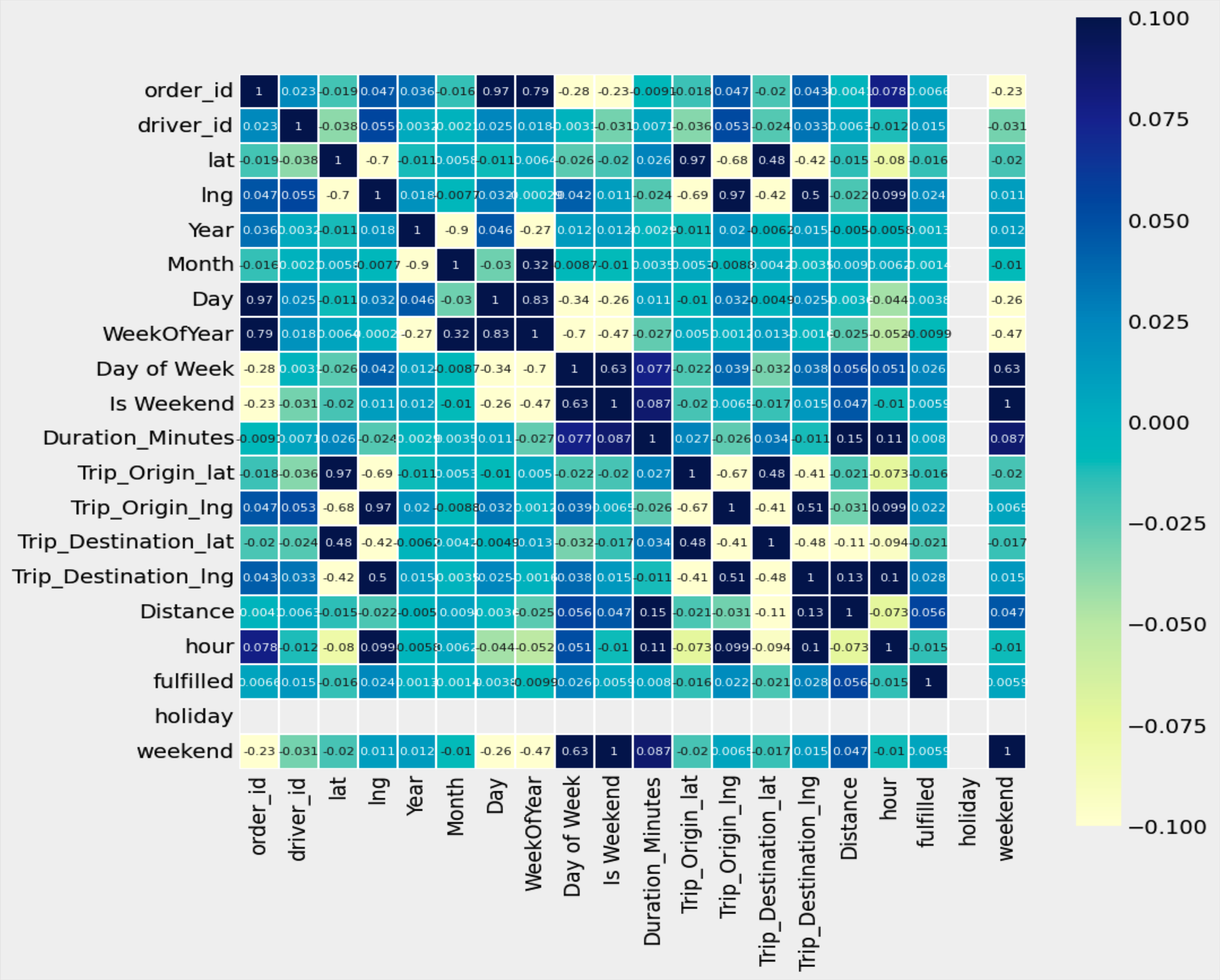
Exploratory Data Analysis



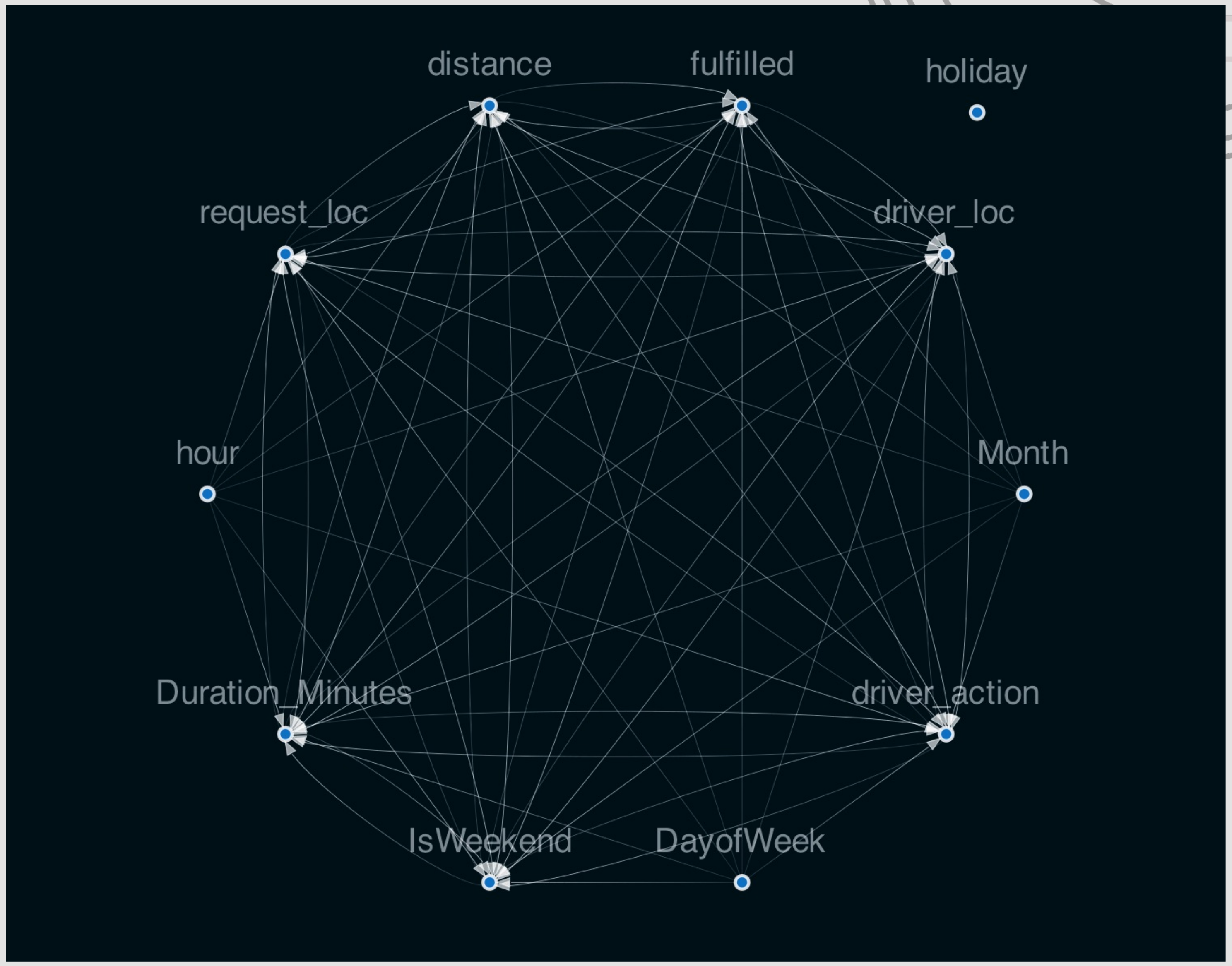


Methodology

correlation matrix



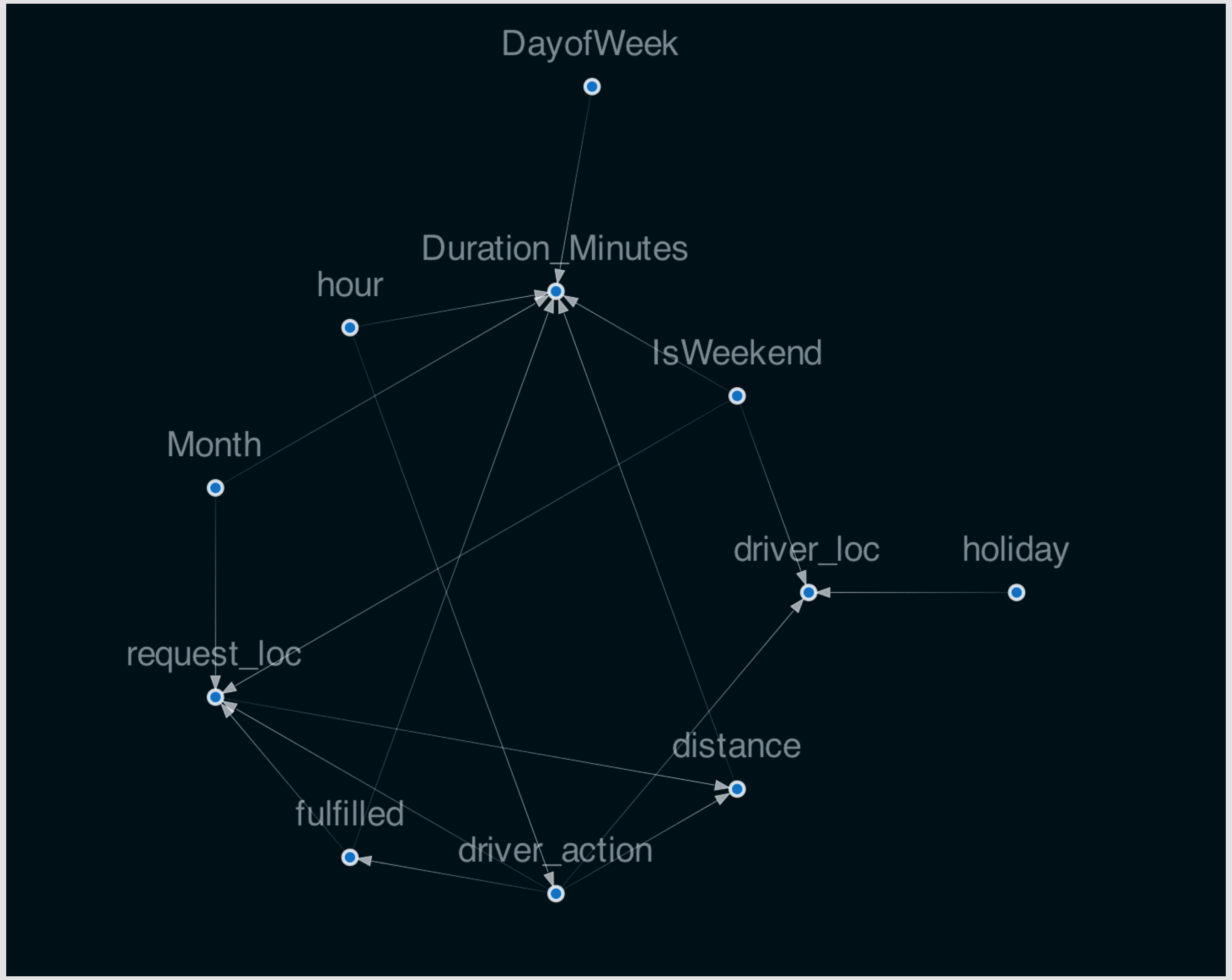
Causal inference graph



Causal inference aims at estimating the causal effect of a specific variable (treatment) over a certain outcome of interest.

Step 1: Preparing the Causal Graph

Causal inference graph



Largest stable graph

Causal inference aims at estimating the causal effect of a specific variable (treatment) over a certain outcome of interest.

The Causalnex package allows you to manually map the causal relationships between different features.

Preparing the Causal Graph

- Step 2: Fitting The Conditional Distribution of the Bayesian Network and preparing the Data
- Then can split the data after this as a train/test.
- Step 3: Modeling Probability
- Step 4: Predict the State from the input Data

```python
# what will happen if all drivers were in 5km of the request

print("marginal fulfilled", ie.query()["fulfilled"])
ie.do_intervention("distance",
                   {'near': 1.0,
                    'far': 0.0})
print("updated marginal fulfilled", ie.query()["fulfilled"])
ie.reset_do("distance")
```

Python

```
marginal fulfilled {'no': 0.9722303727303858, 'yes': 0.027769627269613968}
updated marginal fulfilled {'no': 0.9722303727303858, 'yes': 0.027769627269613968}
```

```python
#  what will happen if all drivers were in 5km of the request

print("marginal action", ie.query()["driver_action"])
ie.do_intervention("distance",
                   {'near': 1.0,
                    'far': 0.0})
print("updated marginal actions", ie.query()["driver_action"])
ie.reset_do("distance")
```

Python

```
marginal action {'accepted': 0.030219775348635153, 'rejected': 0.9697802246513652}
updated marginal actions {'accepted': 0.030219775348635146, 'rejected': 0.969780224651365}
```

- If we decide to bring all the drivers in less that 5km of the requests, from the sampled dataset,
- we could have seen a slight decrease **in accepted requests. however, fulfilled action will not be affected.**

Preparing the Causal Graph

Classification Report:

- The BN shows good performance at classifying the minority class (unfulfilled requests) with good precision,
- but the recall and f1-score are zero for fulfilled.

```python
from causalnex.evaluation import classification_report
classification_report(bn, test, "fulfilled")
```

```
{'fulfilled_no': {'precision': 1.0,
  'recall': 1.0,
  'f1-score': 1.0,
  'support': 50},
 'fulfilled_yes': {'precision': 0.0,
  'recall': 0.0,
  'f1-score': 0.0,
  'support': 0},
 'micro avg': {'precision': 1.0,
  'recall': 1.0,
  'f1-score': 1.0,
  'support': 50},
 'macro avg': {'precision': 0.5,
  'recall': 0.5,
  'f1-score': 0.5,
  'support': 50},
 'weighted avg': {'precision': 1.0,
  'recall': 1.0,
  'f1-score': 1.0,
  'support': 50}}
```

Future plan

- Solve the issue of the imbalanced dataset
- SQL database integration
- Finish ML
- Implement the integer| mixed integer programing

November 2022

THANKYOU

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