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Springboard—DSC Capstone Project 2

PREDICTING PUBLIC TRANSPORTATION SAFETY RISK

HTTPS://GITHUB.COM/TAMARAHORNE/SPRINGBOARD/TREE/MAIN/CAPSTONE%20PROJECT%202

INTRODUCTION

Image credit: www.newschannel5.com

WHAT'S THE SAFETY RISK?

Increasing Public Transportation Options Between Nashville's Convention Center and Airport

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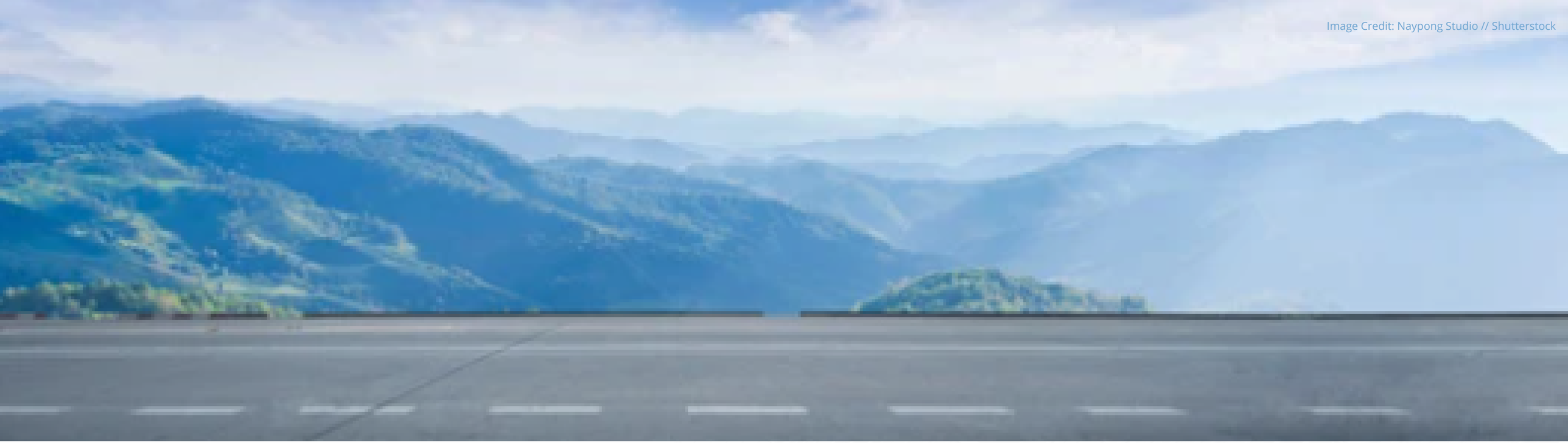
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THE DATA

National Transit Database

- Monthly modal time series data
- 133,196 rows; 65 columns
- One row per month per agency per mode

Wrangling

- Filled NaNs in 4000+ with data found in the dataframe
- Filled NaNs in 27 rows with data from FTA (Federal Transit Administration)

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REDUCING THE COLUMNS

ID Columns

- ✓ 5 DIgit NTD ID
- ✗ 4 Digit NTD ID

Location Columns

- ✓ Primary UZA Population
- ✗ Primary UZA Code

Totals Columns

- ✓ Total Fatalities
  Total Injuries
  Total Events
- ✗ All contributing columns

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MANY SAFETY INCIDENTS FOR MB AND HR

MB = MODE, BUS HR = MODE, HEAVY RAIL

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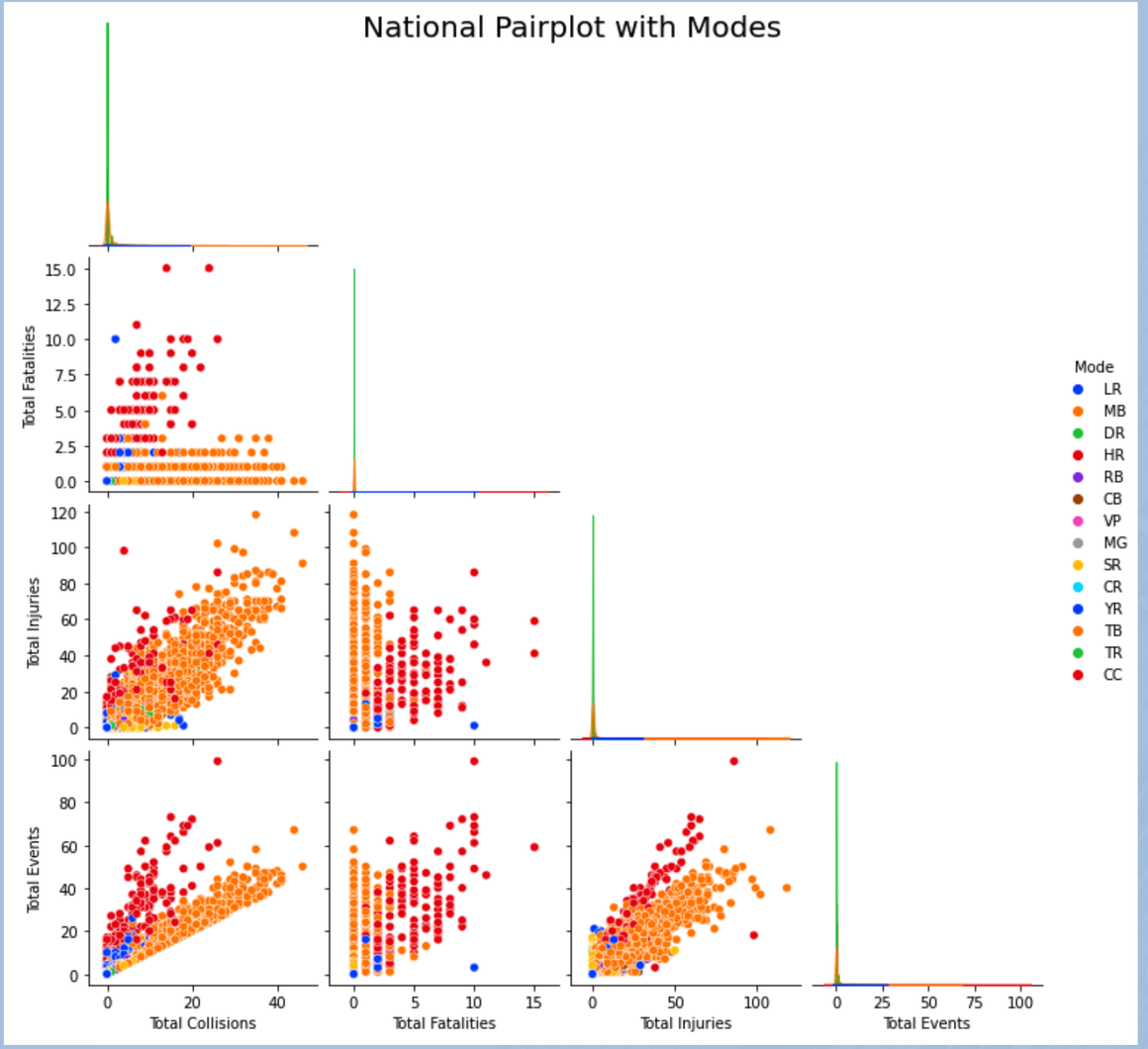
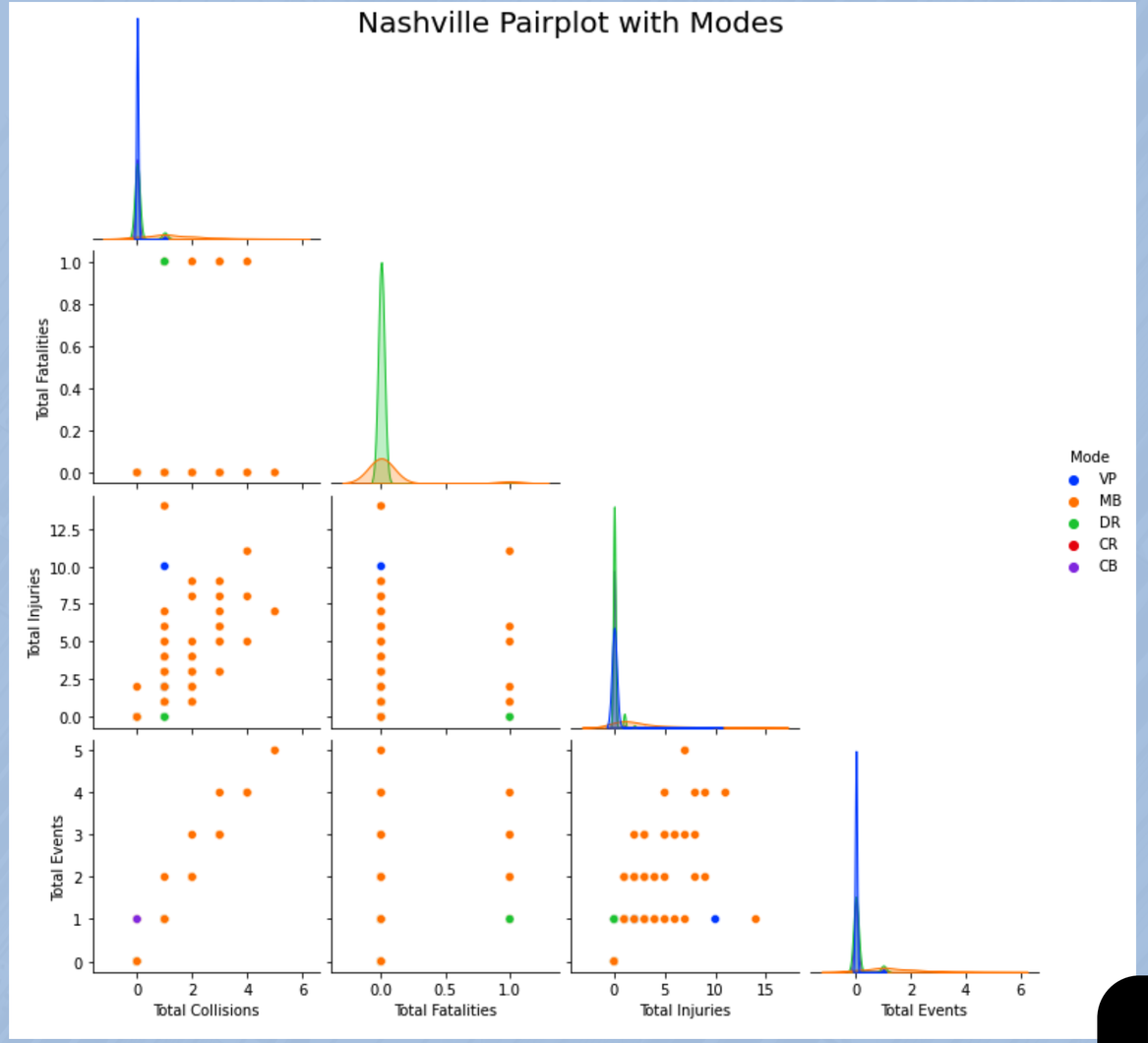




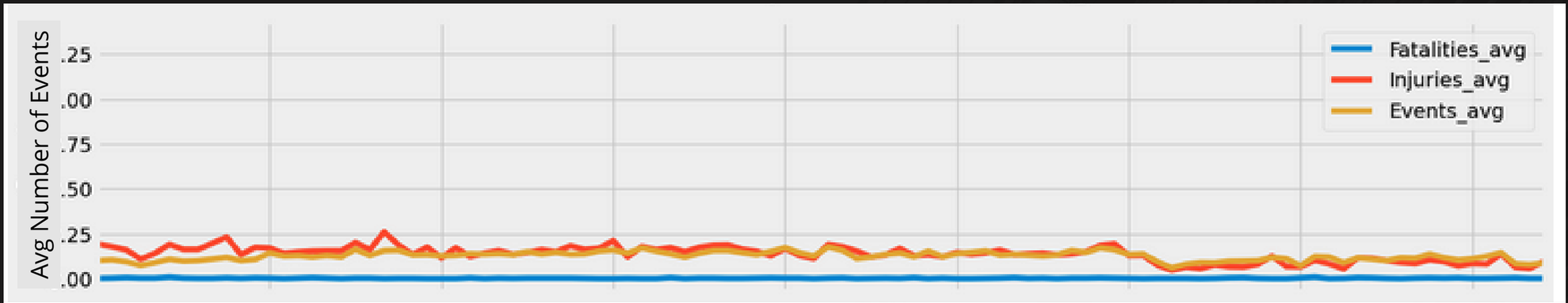
DEFINING THE TARGET

Safety Performance Targets as Reported to the National Transit Database (NTD)							
The targets listed below are based on reviews of the previous five years of MTA dba WeGo Public Transit's safety performance data.							
Mode of Transit Service	**Fatalities (total)**	**Fatalities (per 100 thousand VRM)**	**Injuries (total)**	**Injuries (per 100 thousand VRM)**	**Safety Events (total)**	**Safety Events (per 100 thousand VRM)**	**System Reliability (VRM / failures)**
Fixed Route Bus	0	0	35	.55	24	.45	5,500
Demand Response Bus	0	0	6	.27	6	.26	24,800
Demand Response Taxi	0	0	0	0	0	0	0

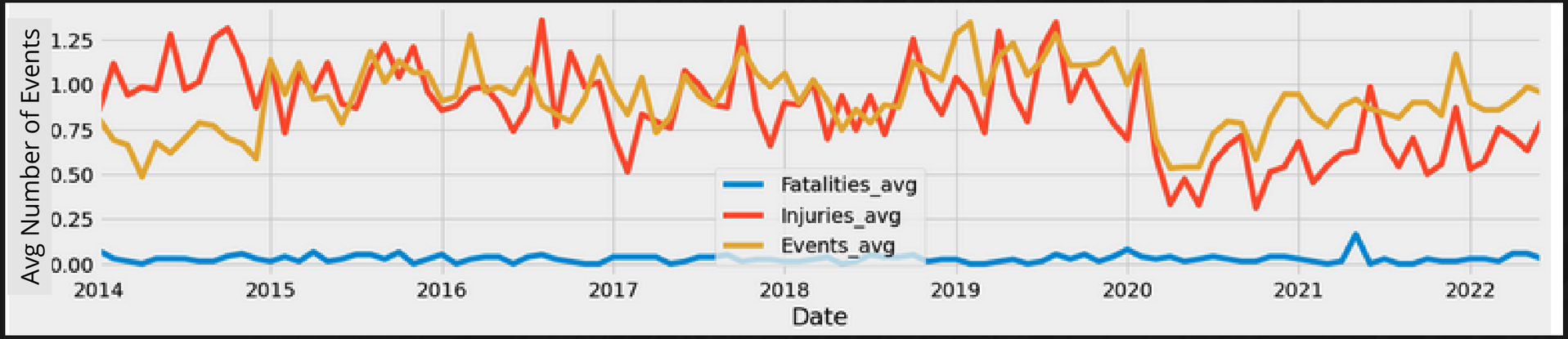
(TOTAL FATALITIES + TOTAL INJURIES + TOTAL EVENTS) / VEHICLE REVENUE MILES

EXPLORATORY AGGREGATION

Locations with Modes up to and Including Nashville's



Locations with Modes up to and Including Nashville's Plus Light Rail



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~modeling_df~	MAPE	RMSE	MAE	R Squared
Linear Regression	12.7%	0.088	0.058	0.645
Random Forest Regressor	7.1%	0.041	0.033	0.902
K Neighbors Regressor	7.5%	0.043	0.035	0.365
XGBoost Regressor	4.8%	0.027	0.022	0.999

MODELING

First Aggregation

Date, nation

What features influence safety risk for the nation as a whole?

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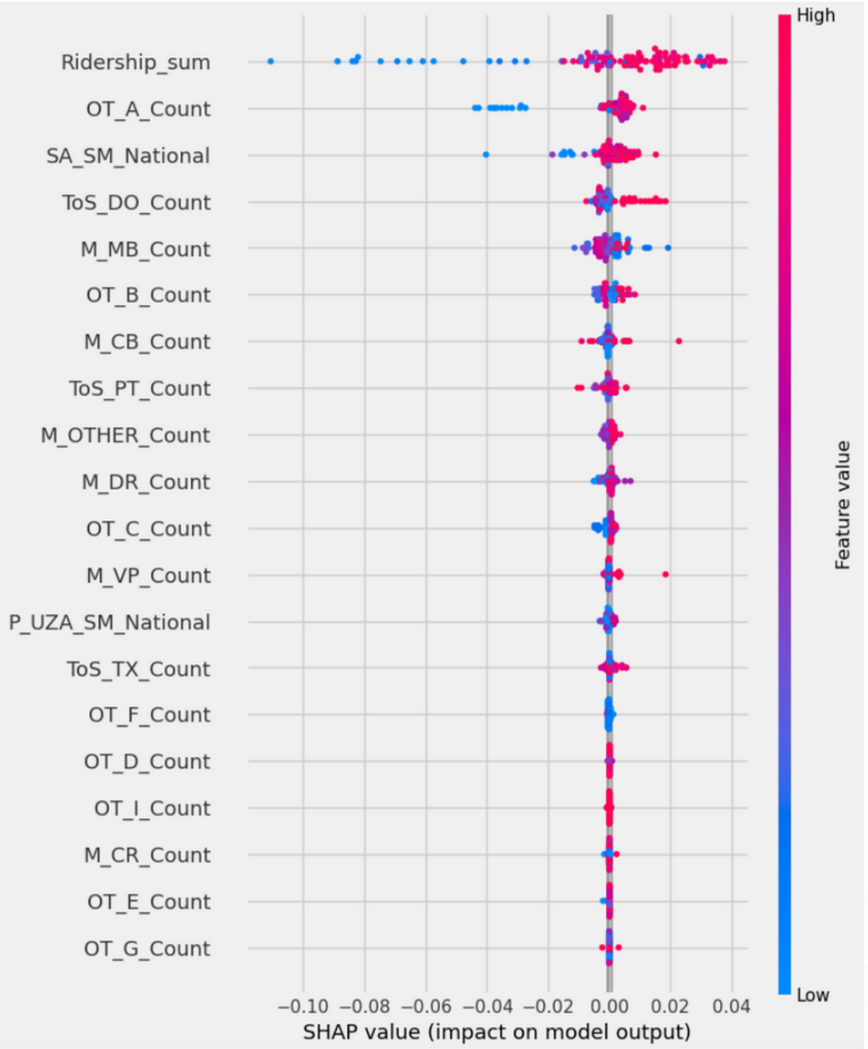

FEATURE IMPORTANCE

Ridership_sum

Lower values decrease safety risk

OT_A_Count

‘Independent Public Agency or Authority of Transit Service’ organization type.

Most frequently occurring organization type in the national data

Lower values decrease safety risk

SA_SM_National

Average service area square miles for the nation during each given month

Lower values decrease safety risk

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~modeling_df2~	MAE	Mean y-test	Mean y-pred	RMSE	R Squared
Linear Regression	0.425	0.299	0.302	0.810	0.251
Random Forest Regressor	0.522	0.299	0.420	0.937	0.833
K Neighbors Regressor	0.395	0.299	0.270	0.938	0.280
XGBoost Regressor	0.454	0.299	0.340	0.899	0.548

MAPE not available due to division by zero

MODELING

Second Aggregation

Date, location

What features influence safety risk when data is aggregated to both date and location (Primary UZA Name)?

SHIFTED RESIDUALS MAKE THE RESULTS LESS TRUSTWORTHY

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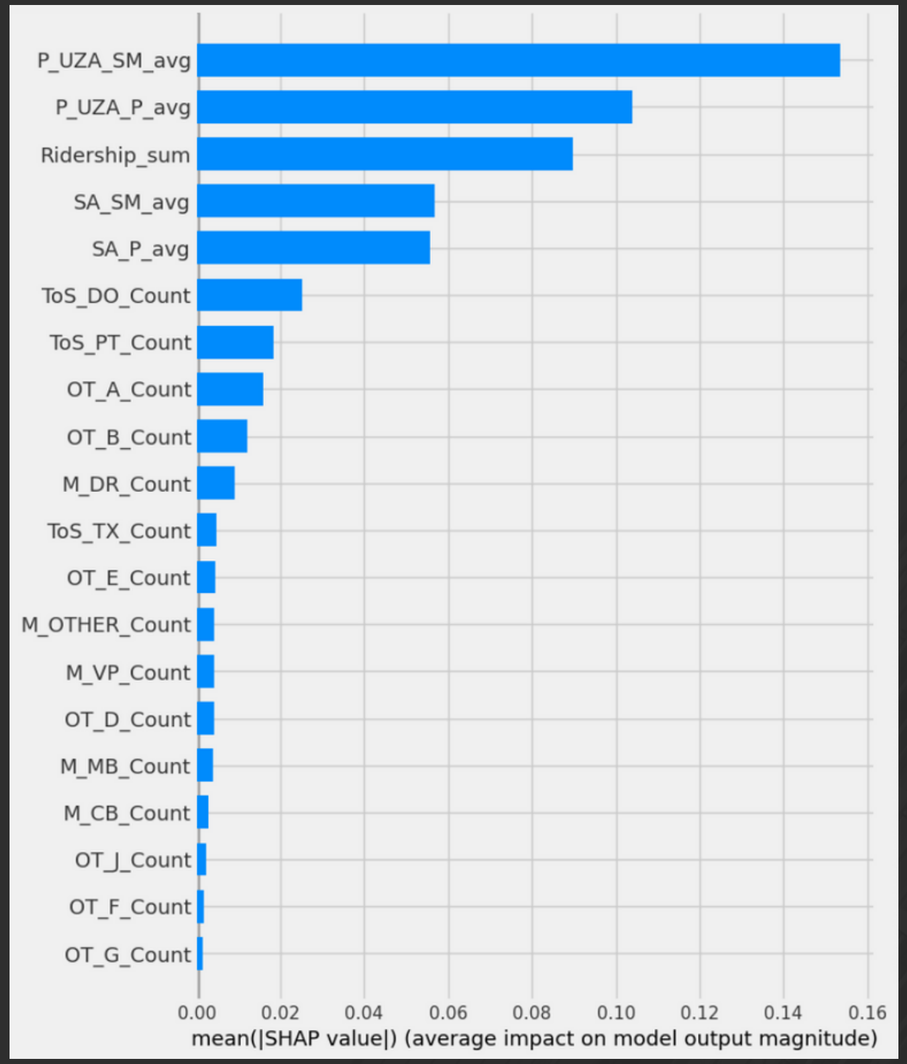
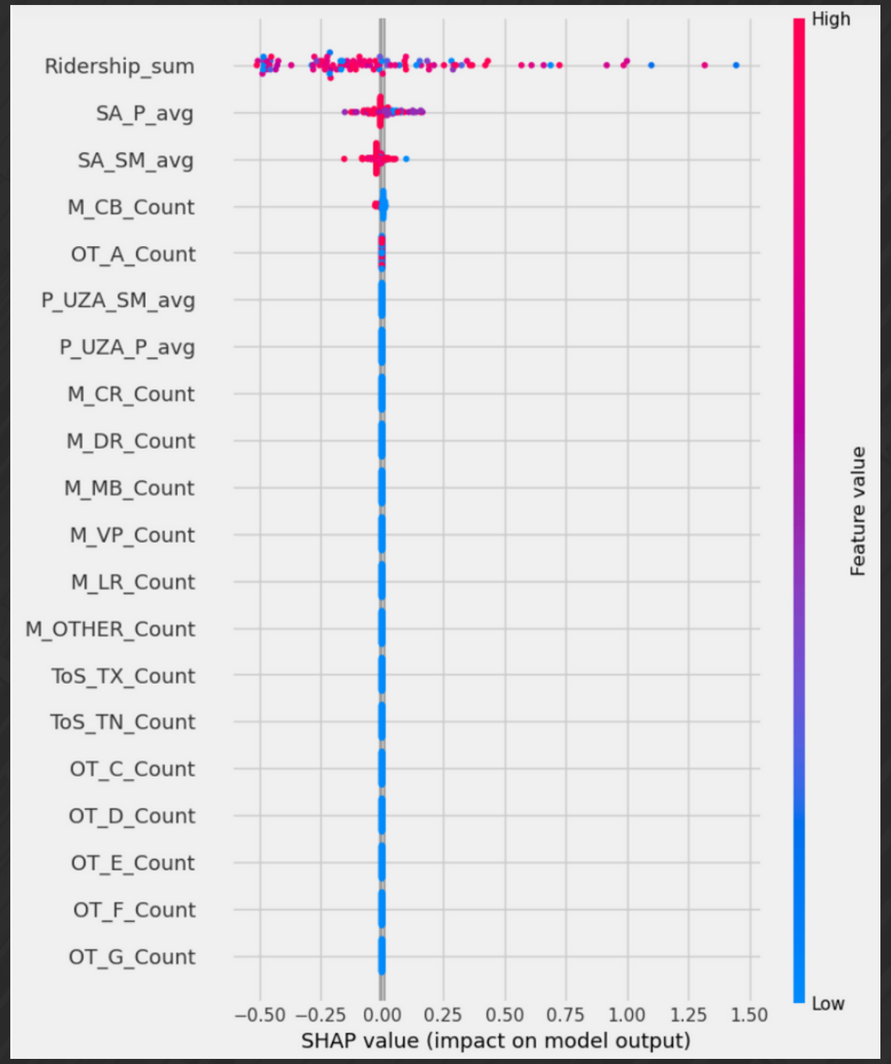
FEATURE IMPORTANCE COMPARISON

National



Nashville



~modeling_df3~	MAE	Mean y-test	Mean y-pred	RMSE	R Squared
Linear Regression	1.403	1.149	1.594	1.893	0.210
Random Forest Regressor	0.680	1.149	0.774	1.503	0.883
K Neighbors Regressor	0.591	1.149	0.767	1.490	0.595
XGBoost Regressor	0.744	1.149	0.830	1.608	0.945

MAPE not available due to division by zero

MODELING

Third Aggregation

Date, mode

What features influence safety risk for the individual modes?

Which modes have the highest and lowest safety risk?

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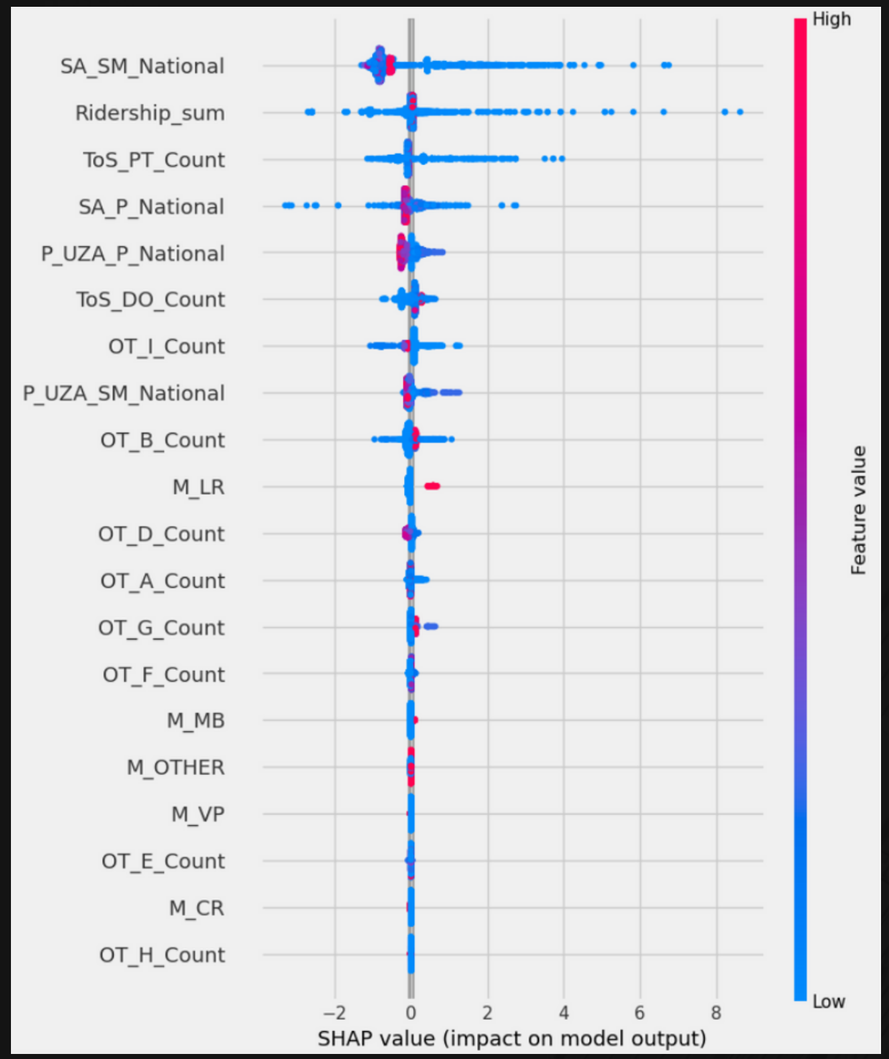
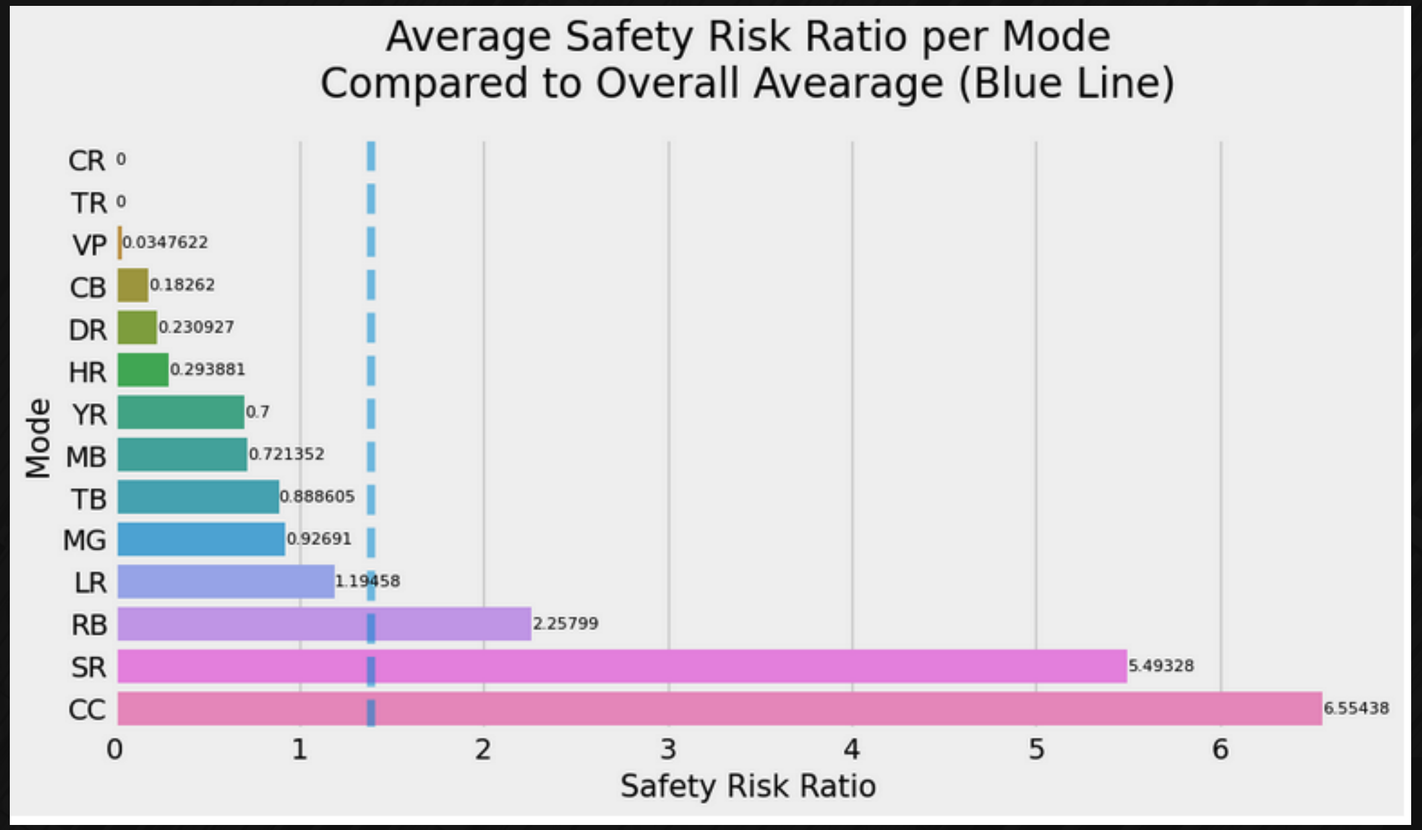
FEATURE IMPORTANCE



MODAL SAFETY RISK



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CONCLUSIONS

Best Models

- XGBoost Regressor
- K Neighbors
- K Neighbors

Aggregations

- Date, Nation
- Date, Location
- Date, Mode

Prediction Power

- Safety risk overall for the nation
- Safety risk for Nashville
- Safety risk for specific modes

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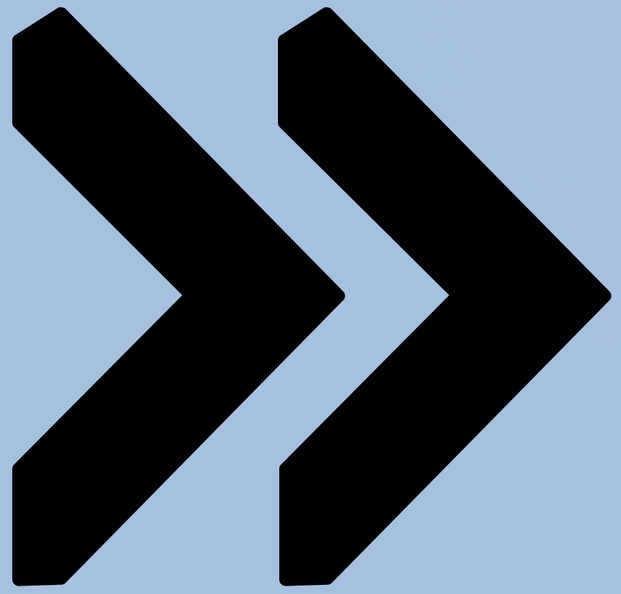
FUTURE WORK



Small

- Diagnose shifted data in modeling_df2
- Explore two low ridership/high SHAP values for modeling_df2
- Use K Neighbors to further explore modeling_df2 and modeling_df3.

Big

- Import data needed for System Reliability and incorporate into the definition of the target
- Time series modeling

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RECOMMENDATIONS

For the Client

YES *Mode* MATTERS

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**Correlation Does Not Mean Causation*

DON'T ADD LIGHT RAIL

Adding light rail would increase safety risk

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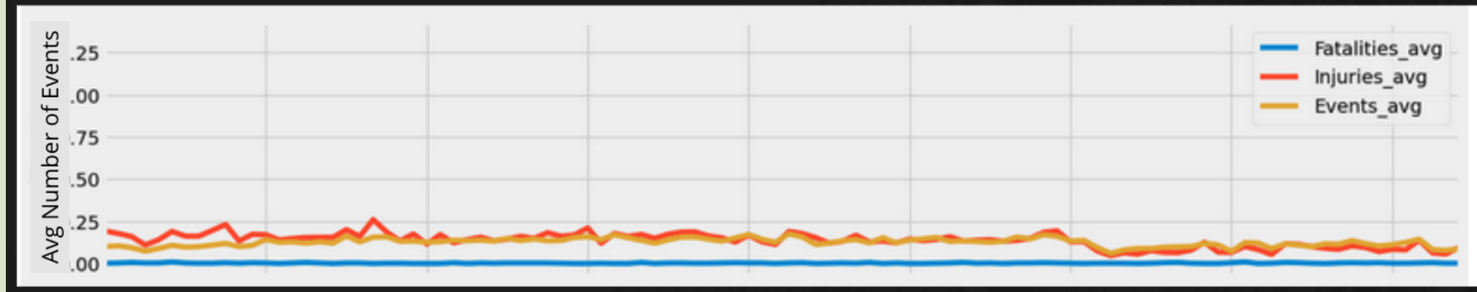
Locations with Modes up to and Including Nashville's



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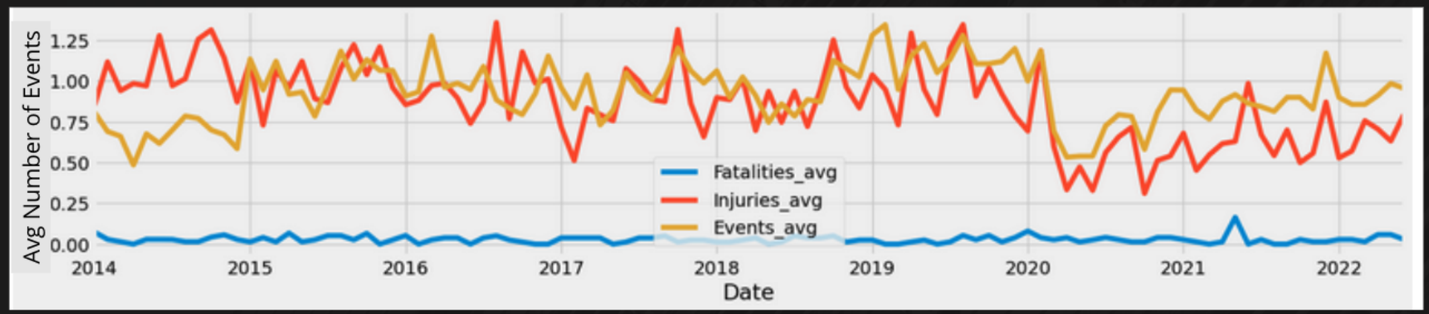
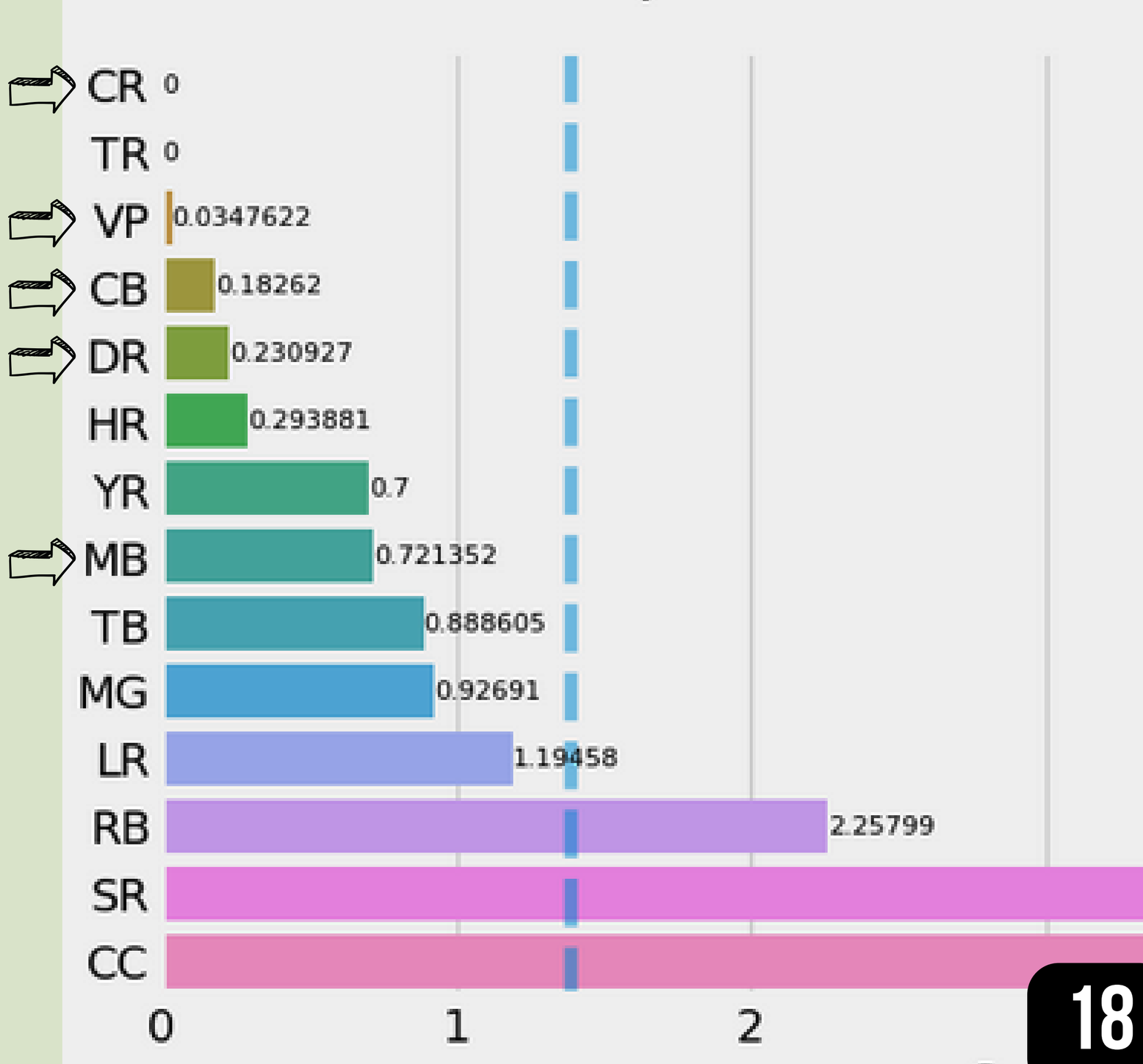


ADD SERVICE TO EXISTING MODES

✓ Safety Risk is lowest for CR

✗ Safety Risk is highest for MB



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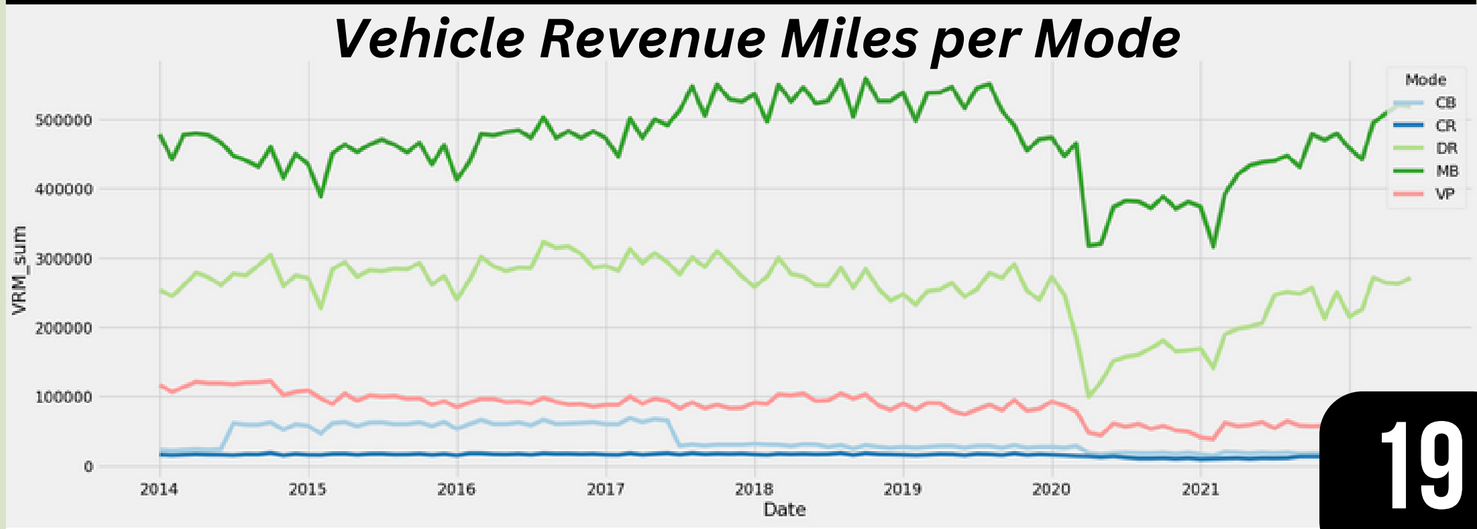
ADD SERVICE TO EXISTING MODES

Added vehicle revenue miles will differ according to mode and this will affect the target

Nashville's Modes

CB: Commuter Bus
CR: Commuter Rail
DR: Demand Response (taxis, etc)
MB: Bus
VP: Vanpool



MORE INFORMATION

https://github.com/tamarahorne/Springboard/tree/main/Capstone%20Project%202

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