



Scooter Transportation Plan for Nashville

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DDA3
March 25, 2021

Agenda

1. The Ask
2. Data Collection
3. Data Analysis
4. Our Recommendation
5. Q & A



The Ask

Overview

- **Goal** - Find the ideal density of available scooters
 - Enable scooters to serve our transportation goals
 - Discourage scooters piling up on sidewalks
 - Keep it economically viable for companies to operate equitably in the city
- **Objectives**
 - Explore the data
 - Clean up the data
 - Analyze the data
 - Develop insights that are supported by our findings

Data Collection

Key Considerations

- Considerations provided by Nashville metro:
 - A major planning goal is to reduce the number of people driving alone.
 - Three rides (of 3 meters or more) per day per scooter is the baseline for ridership goals.
 - The original pilot program limited scooter density to 340 scooters per square mile.
 - SUMD devices may be an important means of transportation in the Promise Zone to help mitigate the "last mile" problem that exists in connecting people where they live to public transportation.

Data Sources

- Polled location datasets (May-July 2019)
- Trip datasets (May-July 2019)
- [Nashville bus stops](#)
- Nashville census blocks
- Nashville promise zones
- Job density by census block (Longitudinal Employer Household Dataset)

Data Cleaning

- How did we explore the data?
 - EDA in Jupyter Notebooks
- What inconsistencies did we find in the data?
 - Trip duration and distance
- How did we clean the data?
 - Converted the data type in DateTime Column, calculated true start and end time for trips
- What changes were made?
 - Dropped unnecessary columns from the datasets, such as duplicates and outliers.
 - Display differences between pre-cleaned data and cleaned data

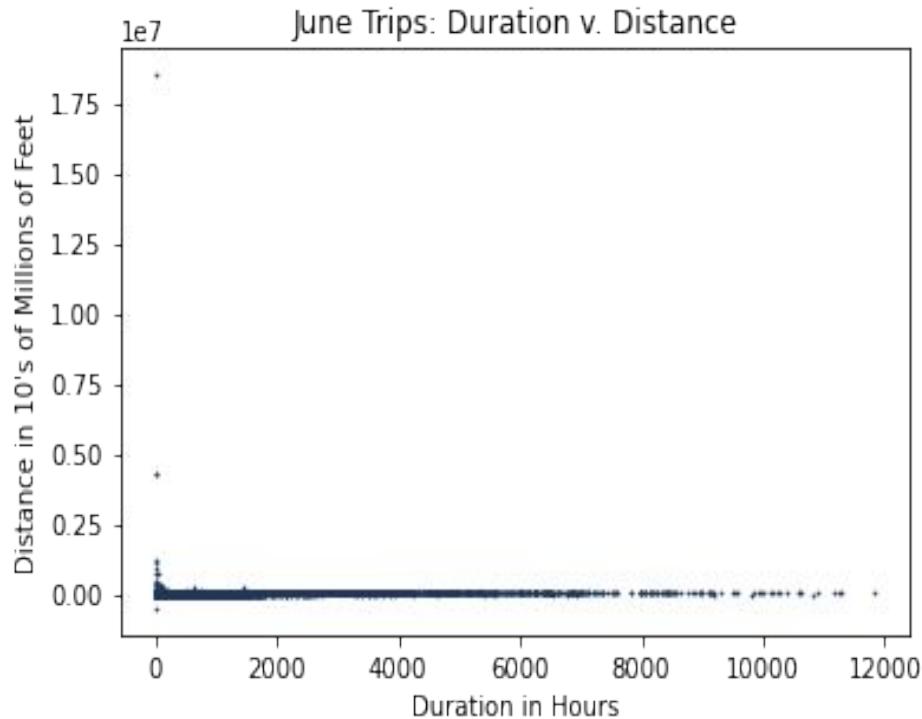


Initial Data Sets

- May:
 - 224k trips logged
 - ~20 million pings from idle scooters
- June:
 - 205k rows
 - ~28 million pings from idle scooters
- July:
 - 135k trips logged
 - ~25 million pings from idle scooters

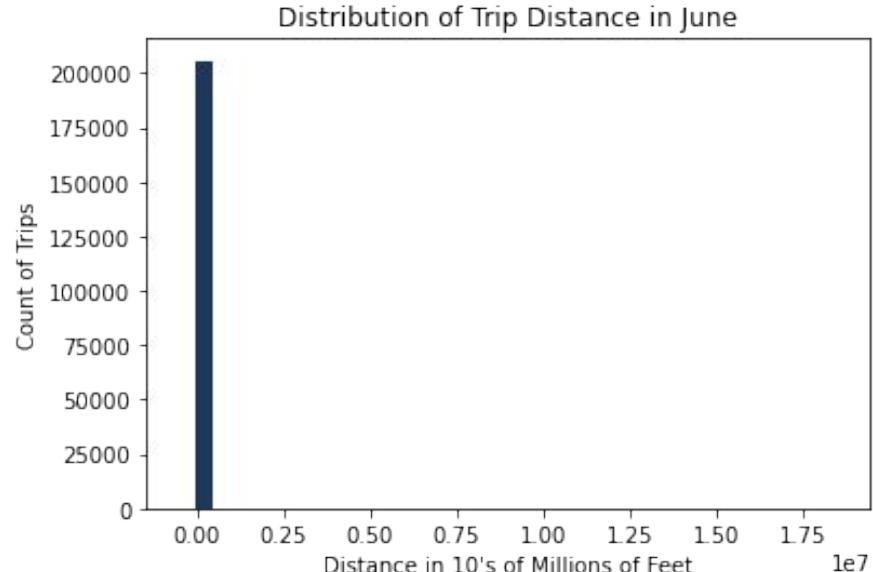
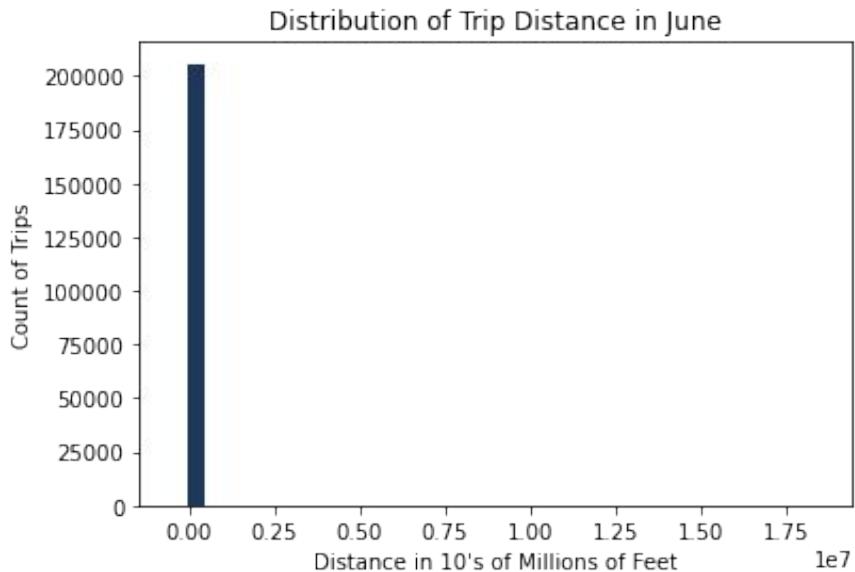
Data Cleaning Process

- Focused cleaning efforts on trip data
- Null values: Not an issue
- Duplicate values: Removed
 - 31k duplicate trips in May
 - 14k duplicate trips in June
 - 500 duplicate trips in July
- Noted irregularities in distance and duration



Irregularities in Trip Duration

- Outliers skewing the data

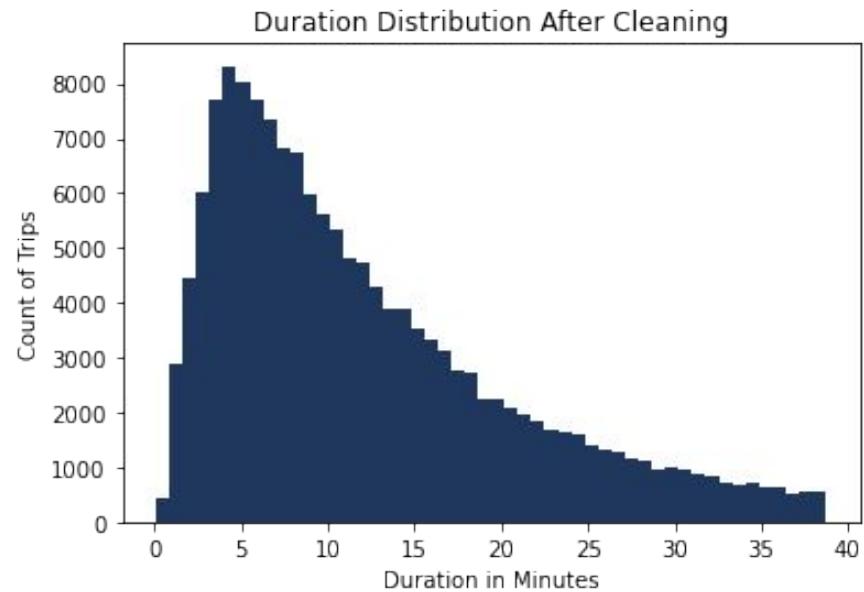
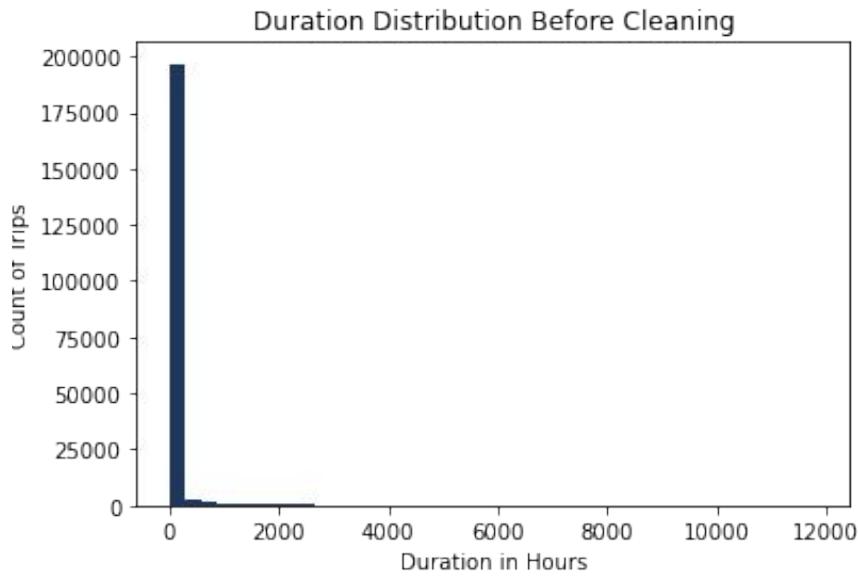


Cleaning Process:

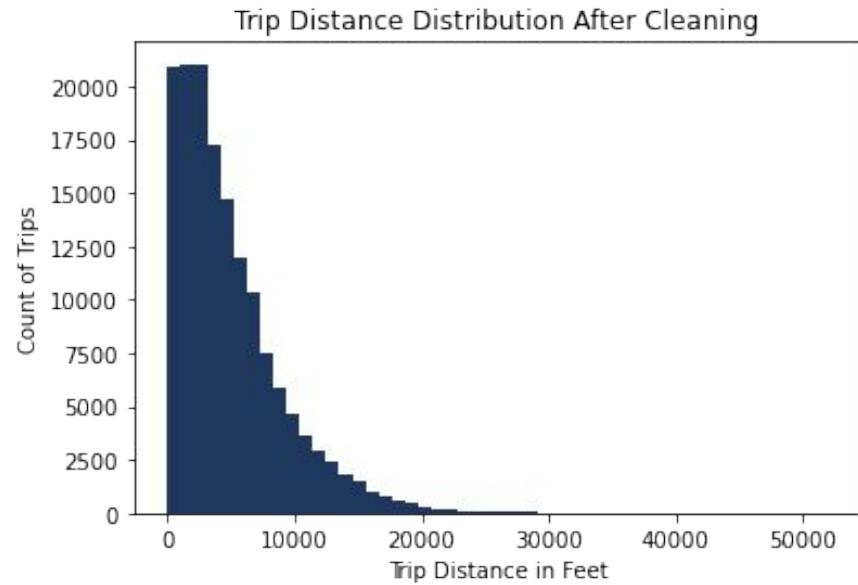
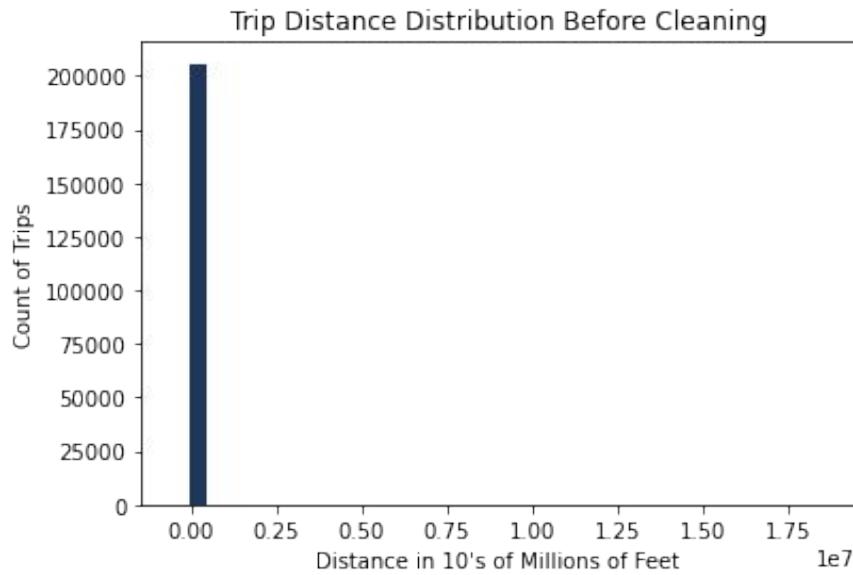
- Removed inconsistent trip duration column, replaced with manually calculated trip duration using start and end times.
- Manually calculated trip distance using coordinates of trip routes.
- Provided cleaned dataset with outliers removed in order to facilitate a more accurate analysis.

What was changed?

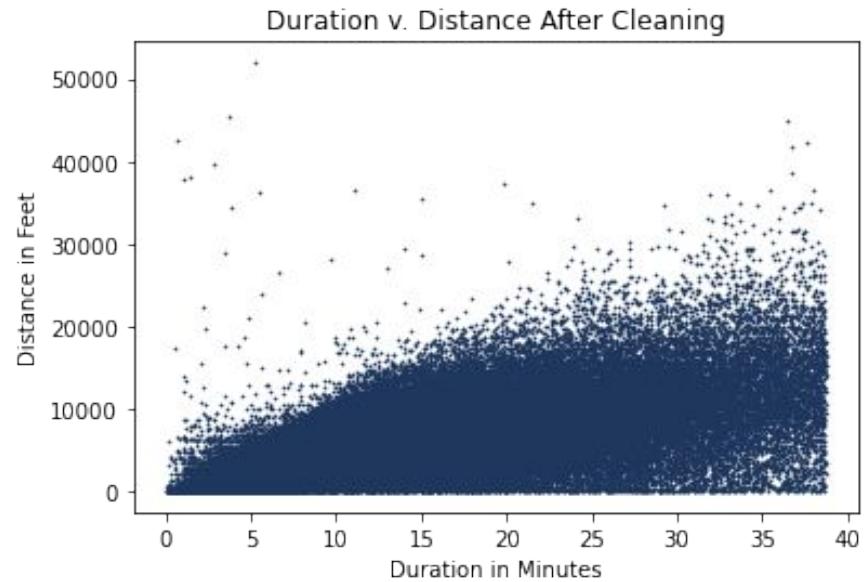
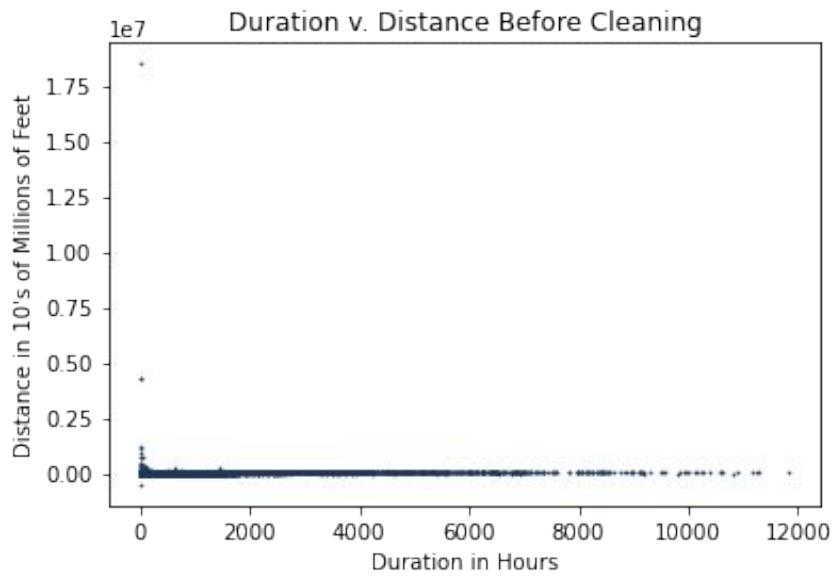
- Removed outliers to see an accurate representation of the data



What was changed? (continued)



What was changed? (continued)



Data Analysis

Analysis by Company

Company Analysis



Est: 2009



Est: 2010



Est: 2012



Est: 2016



Lime

Est: 2017



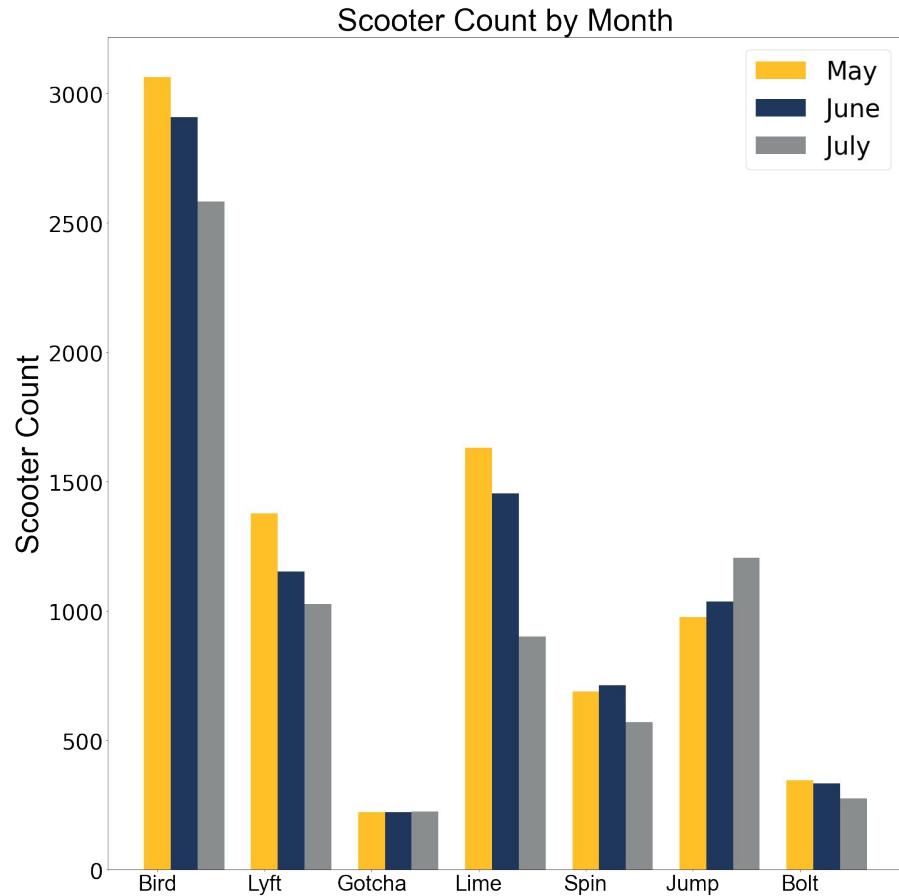
Est: 2017



Est: 2018

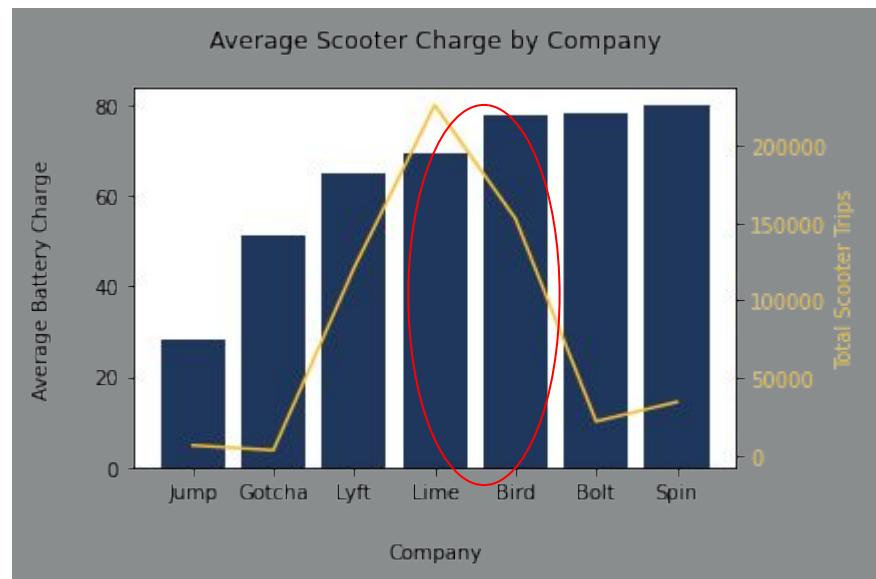
Company Analysis

- Bird has the most scooters available
- Bird also has 2x as many as the next company, Lime
- 5 out of 7 companies removed scooters each month



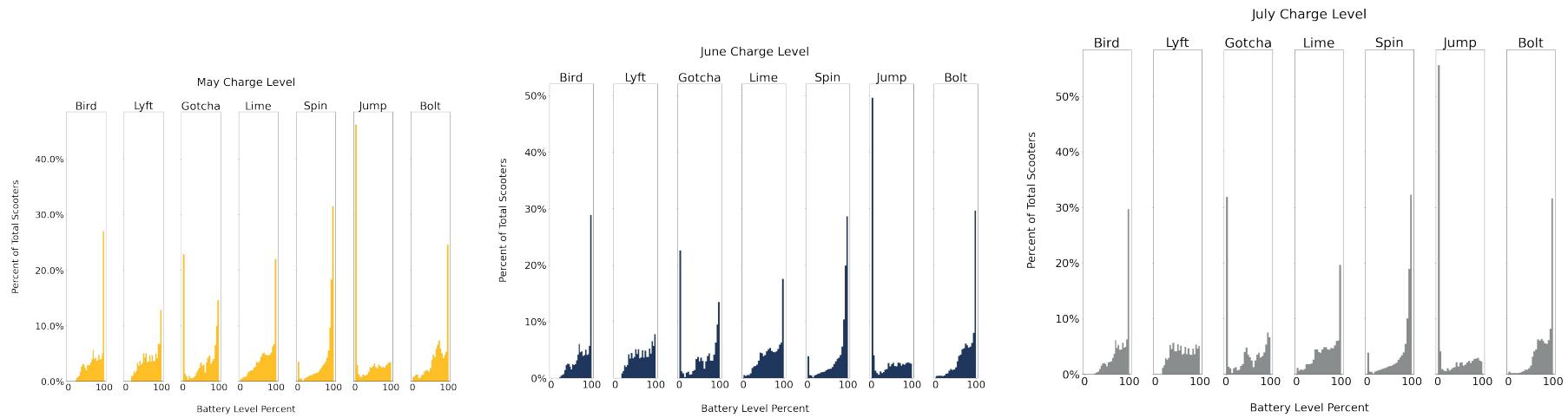
Company Analysis

- Bird and Lime stand out as able to maintain high average charges while servicing high number of trips.



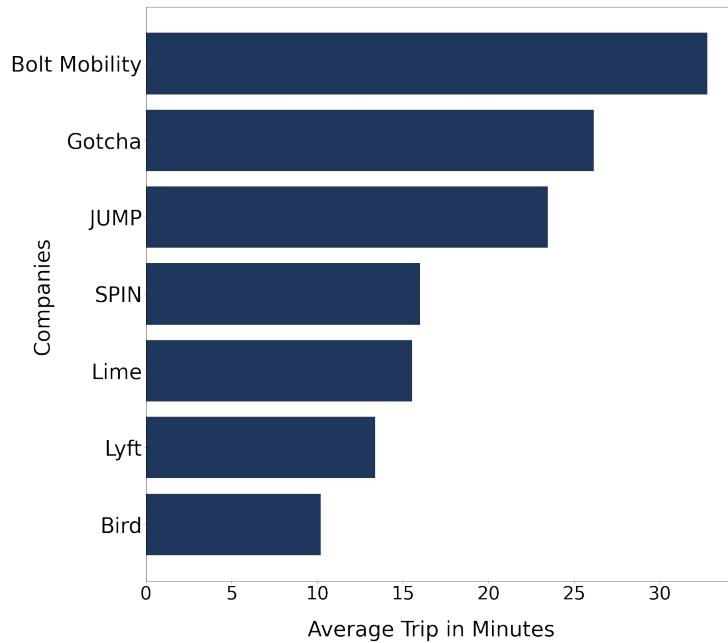
Company Charge Level by Month

- Which companies had the most scooters with low battery percent?
 - Jump consistently has low battery power
 - Most scooters are below 10% battery
- From May to July, Gotcha, increases poor battery life steadily
 - Jump drastically loses battery maintenance from month to month.

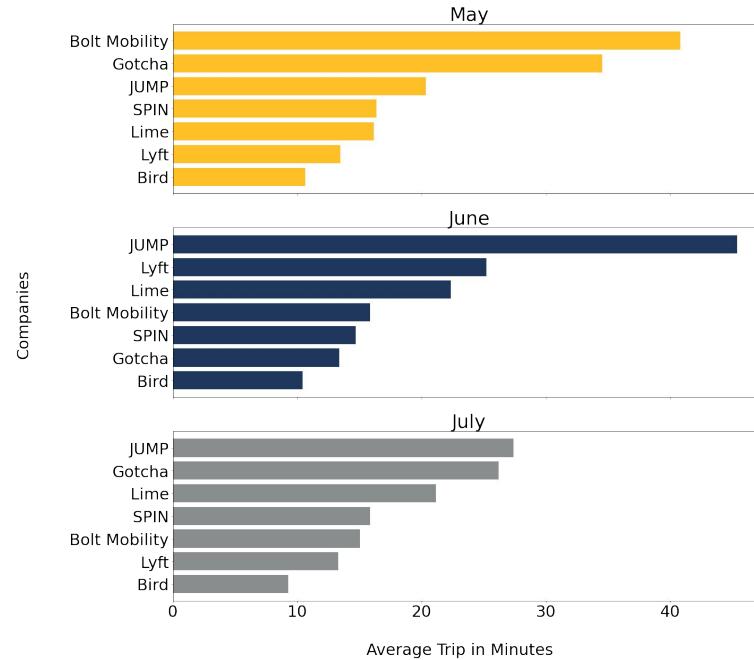


Company Analysis

May-July Average Trip Duration per Company



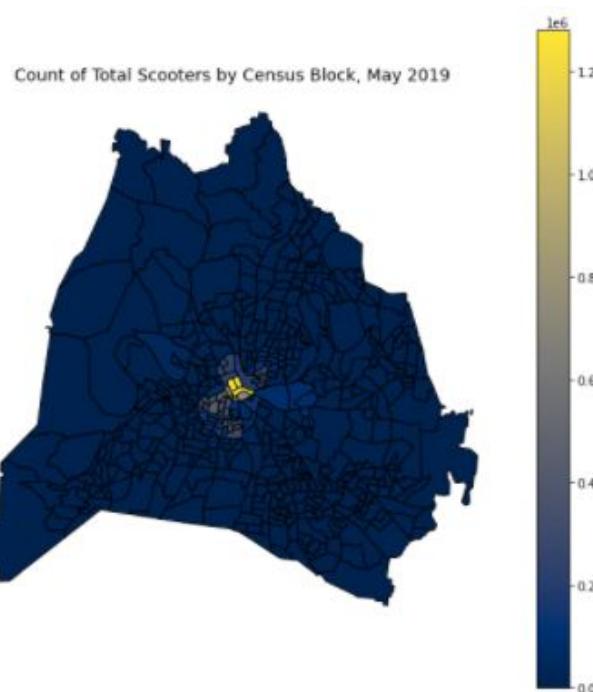
Average Trip Duration by Month per Company



Analysis by Location

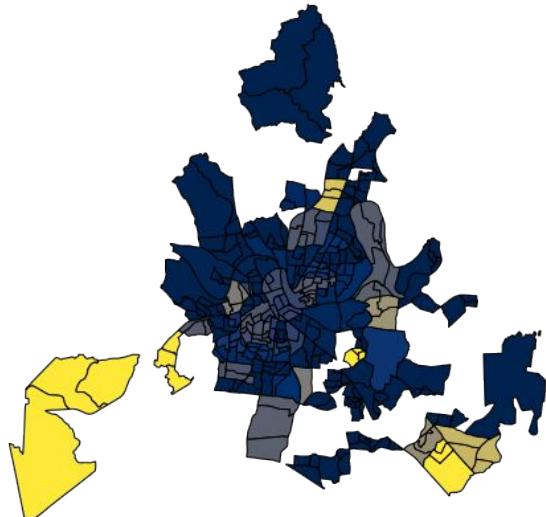
Scooter Collection and Placement

- Charging and Placement Process:
 - Lime and Bird pay people to charge scooters overnight. Charging is done using recommended, purchased chargers and scooters are placed for use the next day in designated areas referred to as “Limehubs” and “Nests.”
 - Spin has “Spinhub,” which are e-scooter parking and charging stations.
- Findings:
 - There are more scooters at 100% charge being placed downtown.
 - Some 100% charged scooters are being dropped off in areas outside downtown, but there is a low density.
 - Data also shows that there is a high percentage of scooters areas outside downtown with a charge of 0%, which means that when available, scooters are being used.

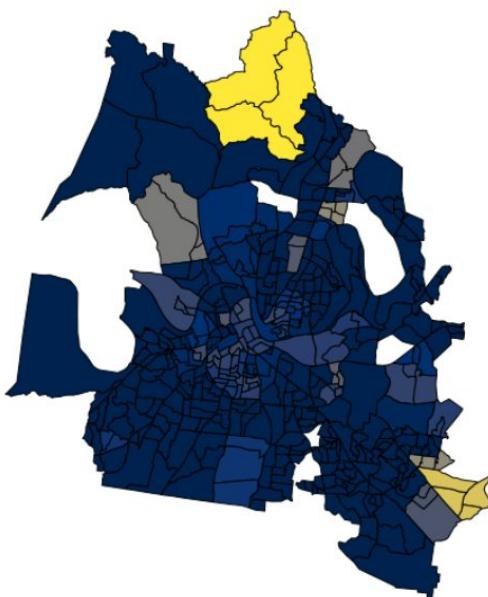


Heat Map Showing Percentage of 100% Charged Scooters

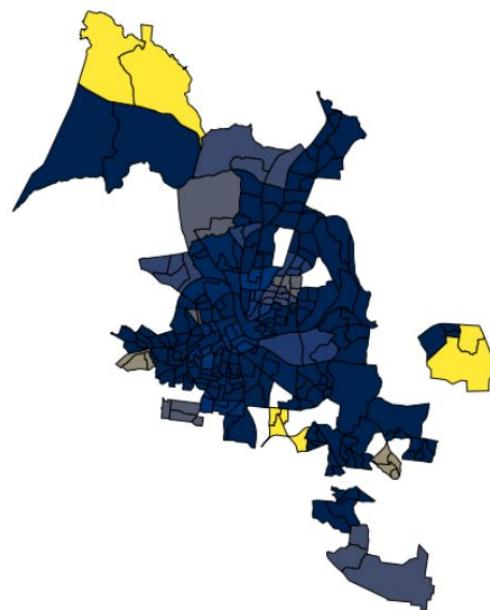
Fully Charged Bird Scooters Distribution, May 2019



Fully Charged Lime Scooters Distribution, May 2019



Fully Charged SPIN Scooters Distribution, May 2019



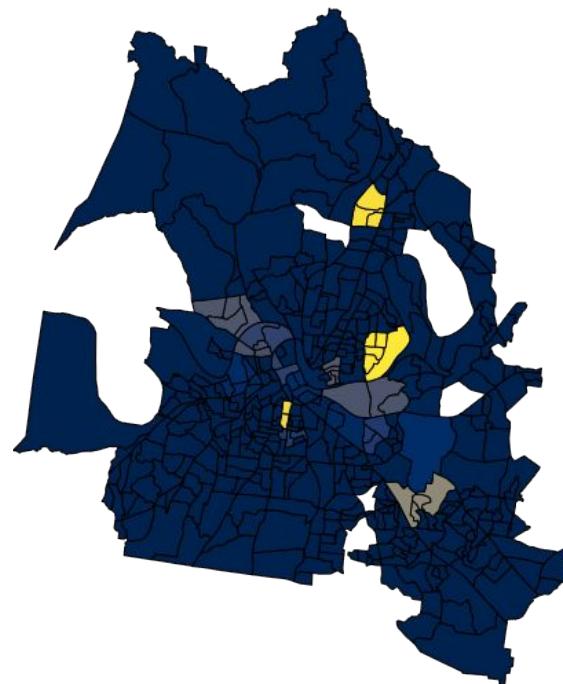
*Census blocks will not appear on map if there are no scooters in the area.

Heat Map Showing Percentage of 0% Charged Scooters

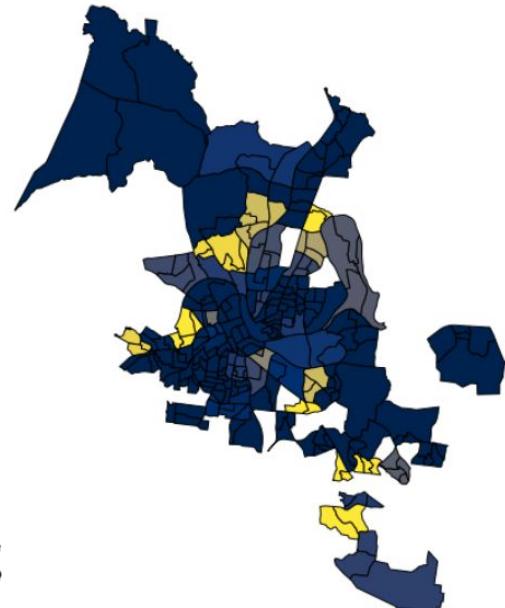
Less Than 25% Charged Bird Scooters Distribution, May 2019



Zero Charged Lime Scooters Distribution, May 2019



Zero Charge SPIN Scooters Distribution, May 2019



*Bird didn't have scooters with charge as low as 0%. Instead we used <25% charge.

*Census blocks will not appear on map if there are no scooters in the area.

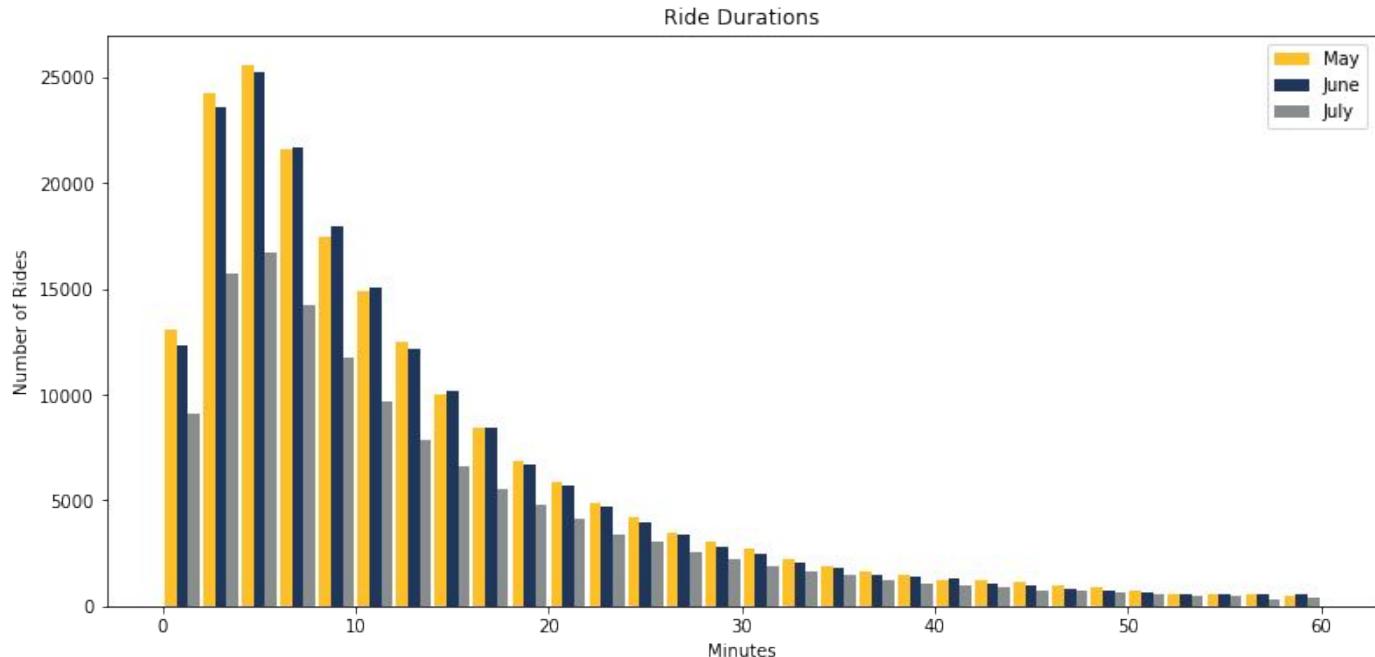
Opportunity

- While a higher scooter density will be needed on the weekends to support tourists and downtown activity near Broadway, this may not need to be the case during the week.
- With fewer tourists and more people working remotely during the week, there is an **opportunity to increase density of scooters in the surrounding areas of downtown.**
- As our analysis shows, there is a high percentage of scooters with 0% charge being found in surrounding areas outside of downtown. **If chargers supplied these areas with more 100% charged scooters, we expect that we might see an increase in usage in addition to longer rides.**



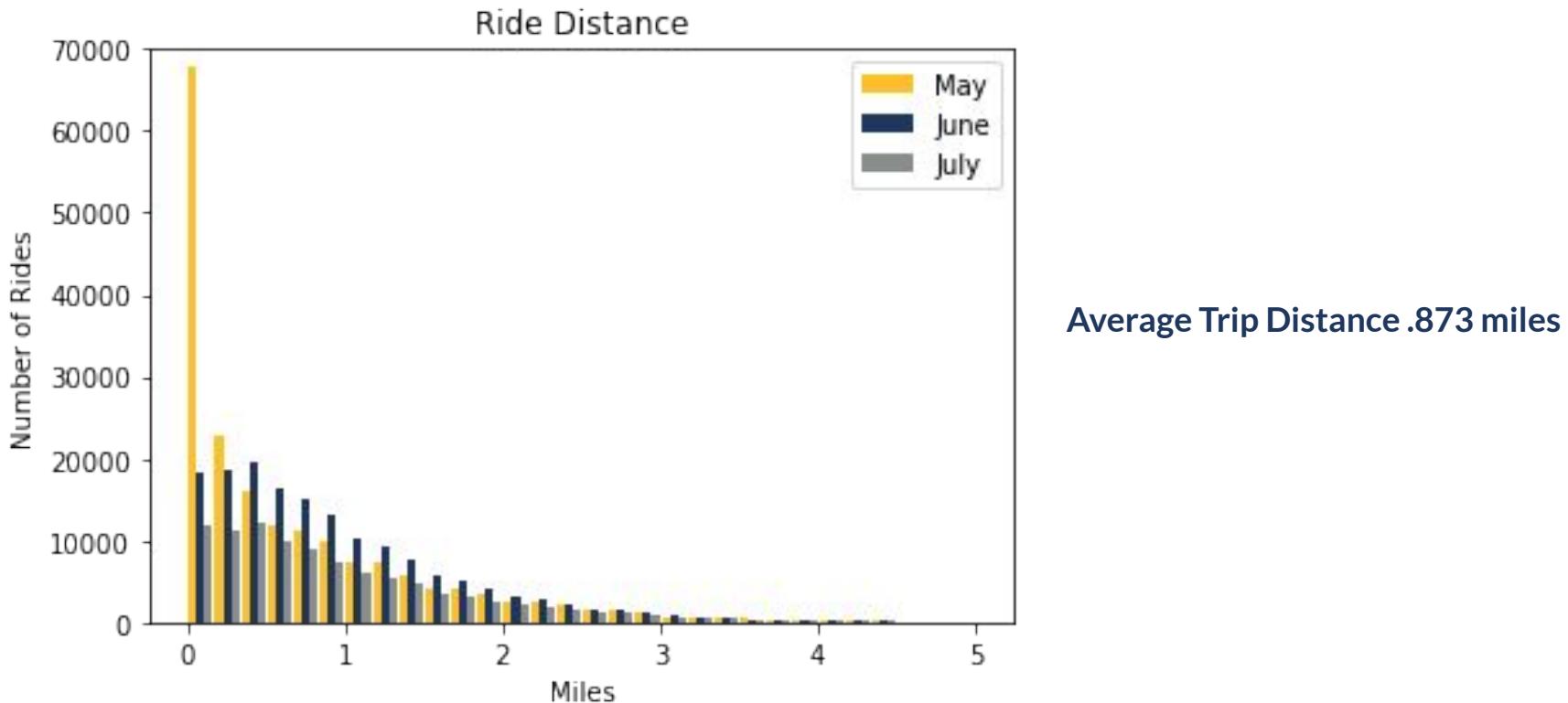
Analysis by Duration/Distance

True Trip Duration



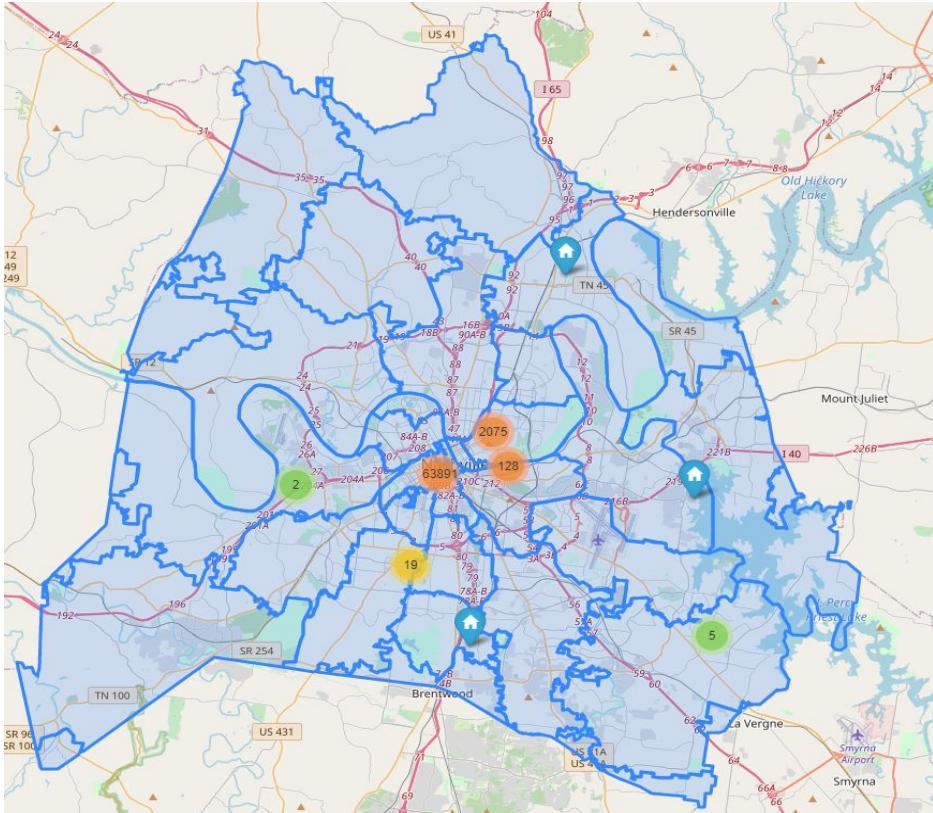
Average ride is
16 minutes

True Trip Distance



Analysis by Areas of Usage: High/Low

Areas of High/Low usage

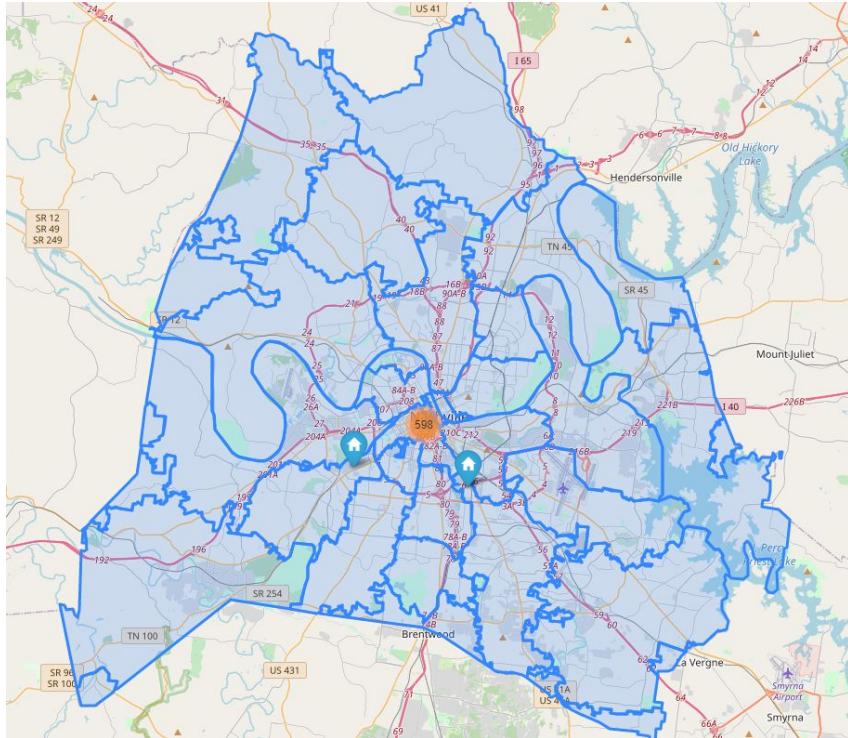


All scooter's rides in month of May

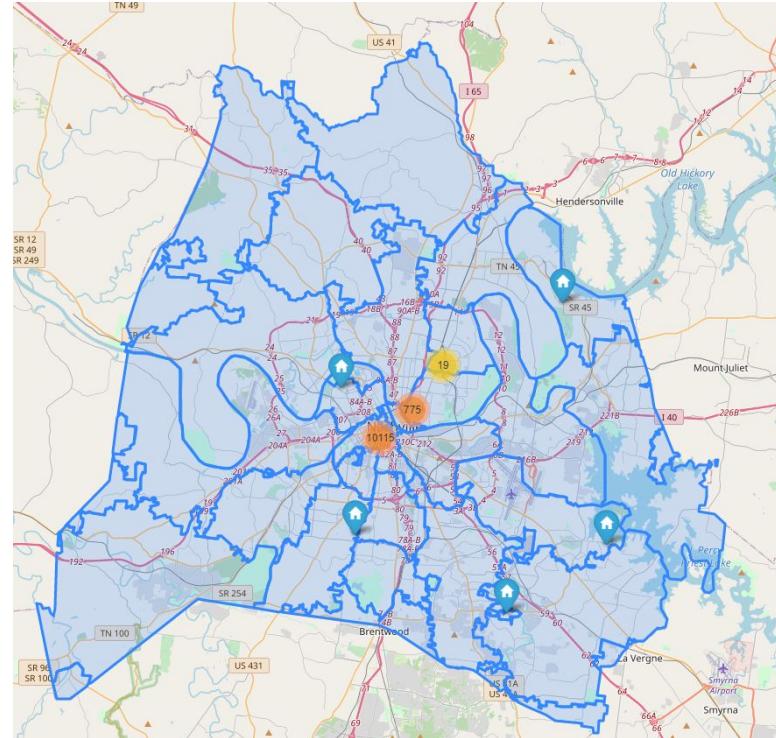
- Looked at start Longitude and start Latitude to determine the position of each scooter
- A majority of rides are located in 'Downtown' - comprising of ZIP codes 37201, 37203, 37219
- There is also a large cluster of scooters near Nissan Stadium
- Low usage in residential areas of Nashville

Areas of High/Low usage

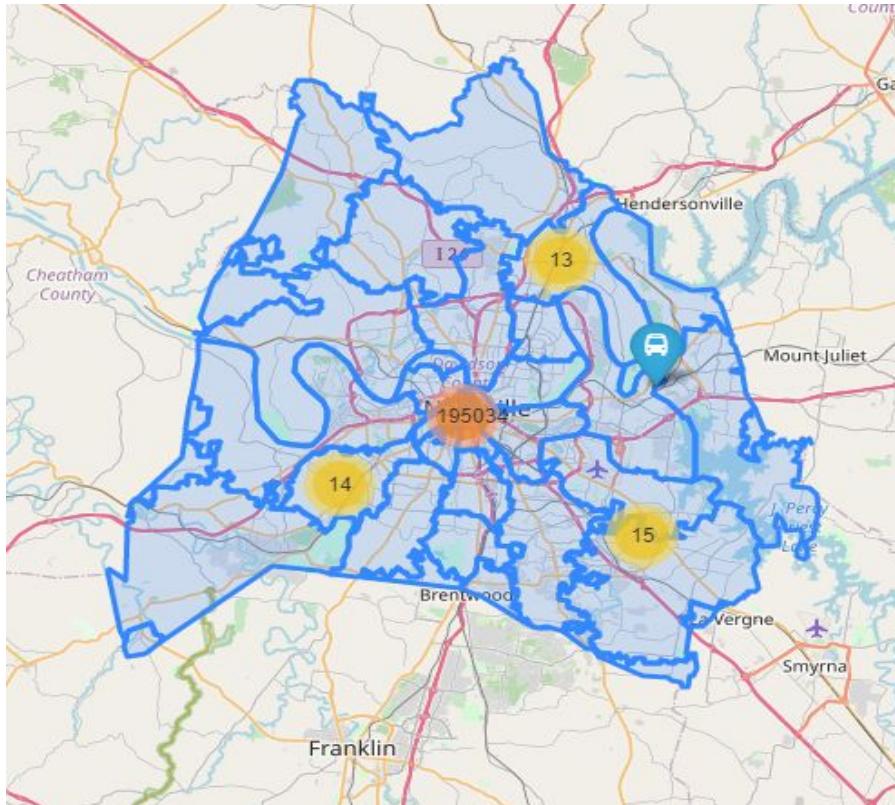
Scooters with over 140 rides in May



Scooters with under 30 rides in May



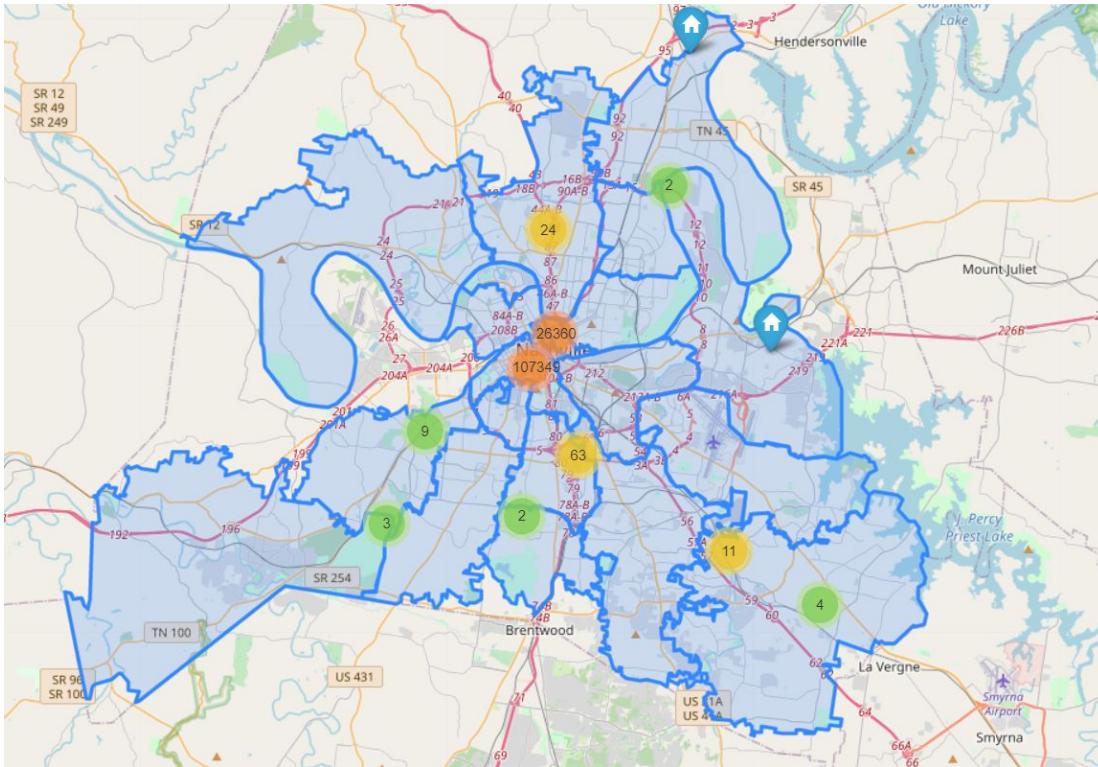
Areas of High/Low usage



All scooter's rides in month of June

- Looked at start Longitude and start Latitude to determine the position of each scooter
- A majority of rides are located in 'Downtown' - comprising of ZIP codes 37201, 37203, 37219
- Low usage in residential areas of Nashville

Areas of High/Low usage

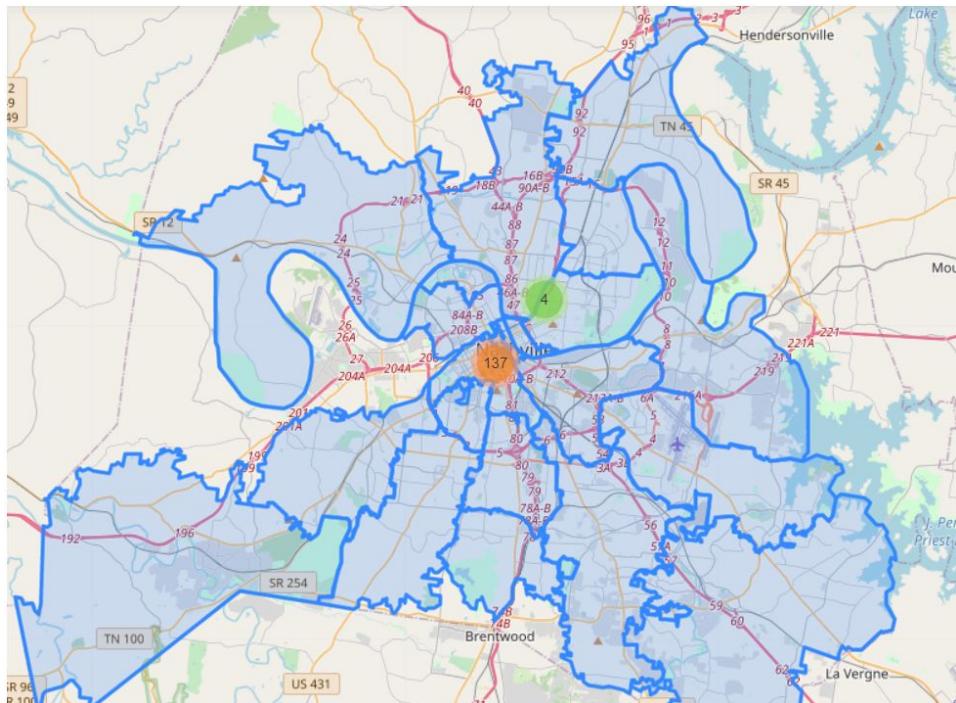


All scooter's rides in month of July

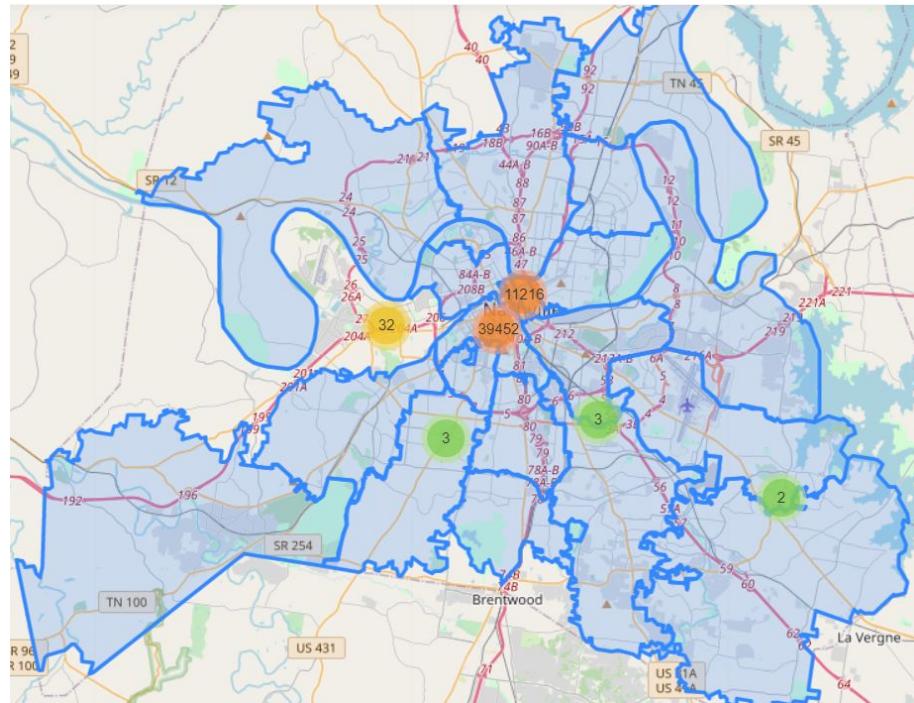
- High usage in Nashville downtown area. In zip codes
37203 65135
37201 26237
37219 11828
- Low usage in residential areas of Nashville.

Areas of High/Low usage

Scooters with over 140 rides in July



Scooters with under 30 rides in July

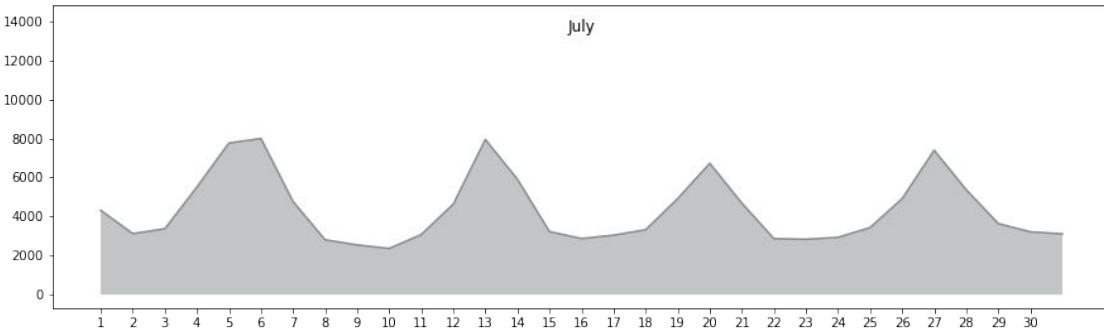
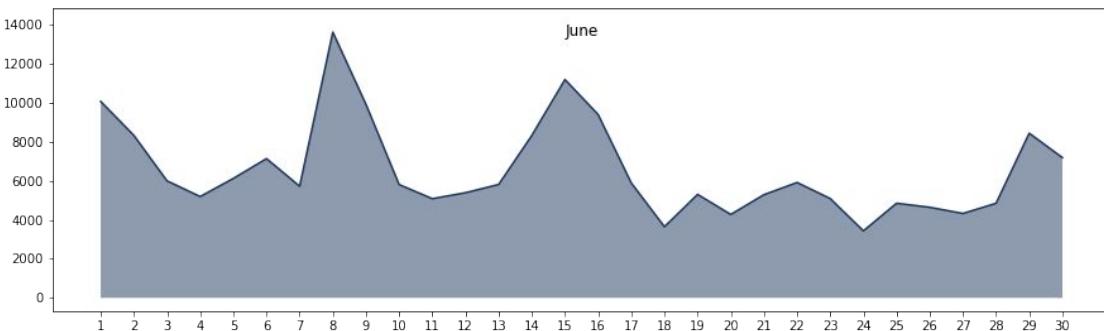
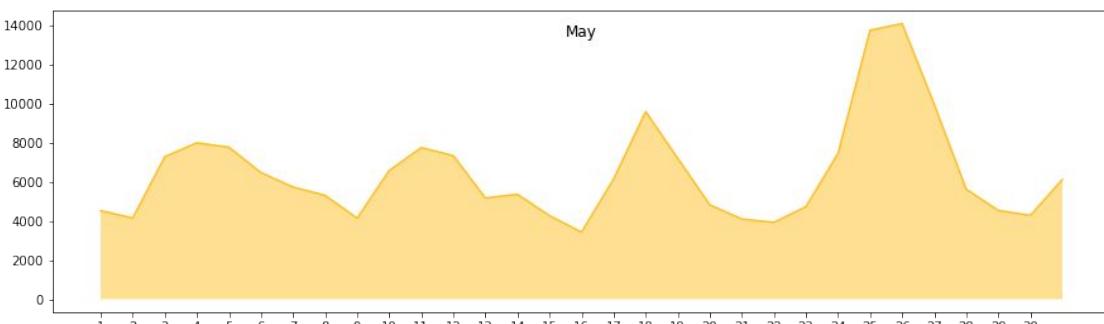


Analysis by Time of Day

Daily Number of Trips

- Average number of trips: 5,770
- Least amount of trips: 2,364
- Most amount of trips: 14,123

- Includes all 7 companies
- Usage peaks on weekends
- **May 25th-26th:** Memorial Day Weekend
- **June 8th - 9th:** CMA Fest
- **July:** weekends

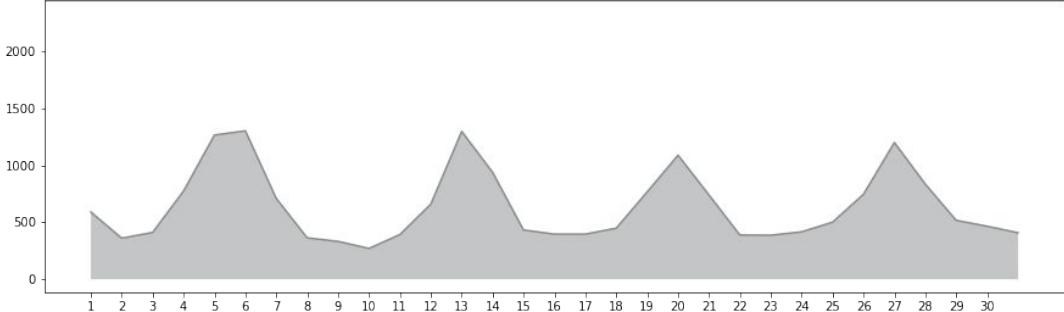
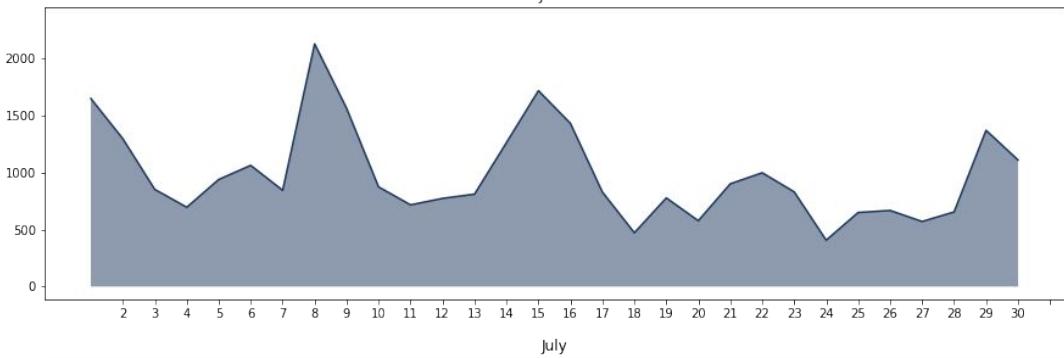
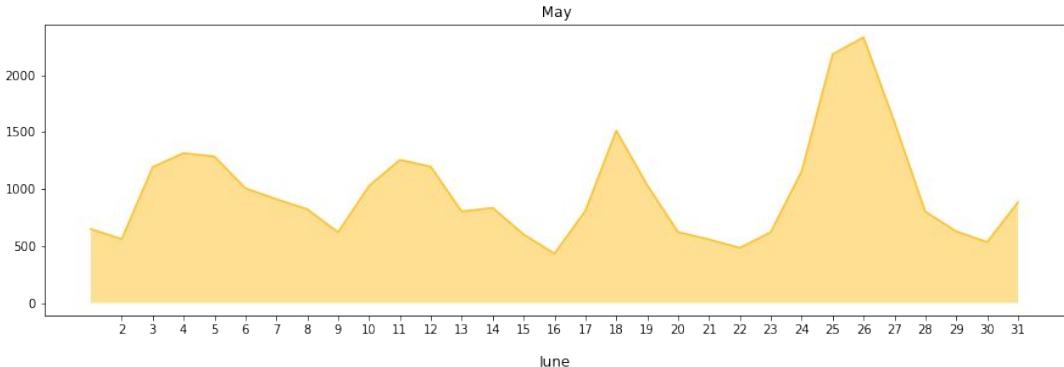


Trips per Time Segment



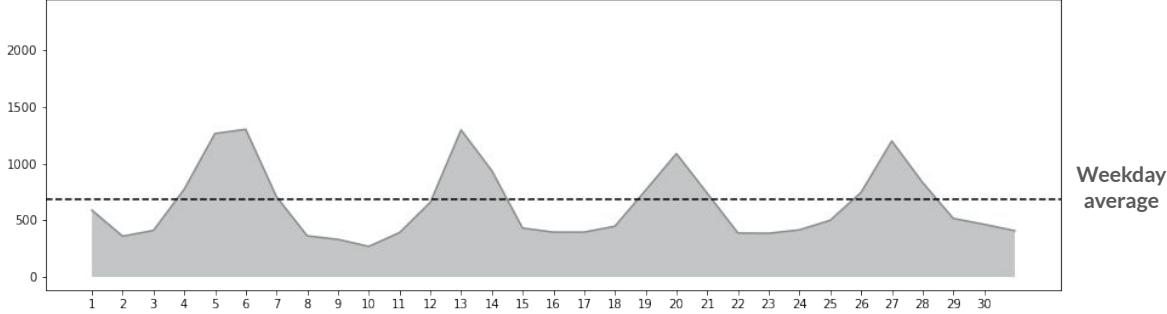
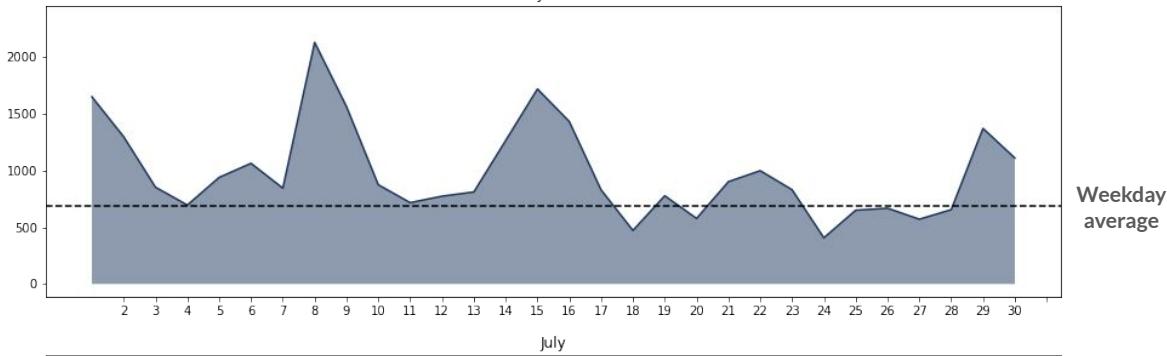
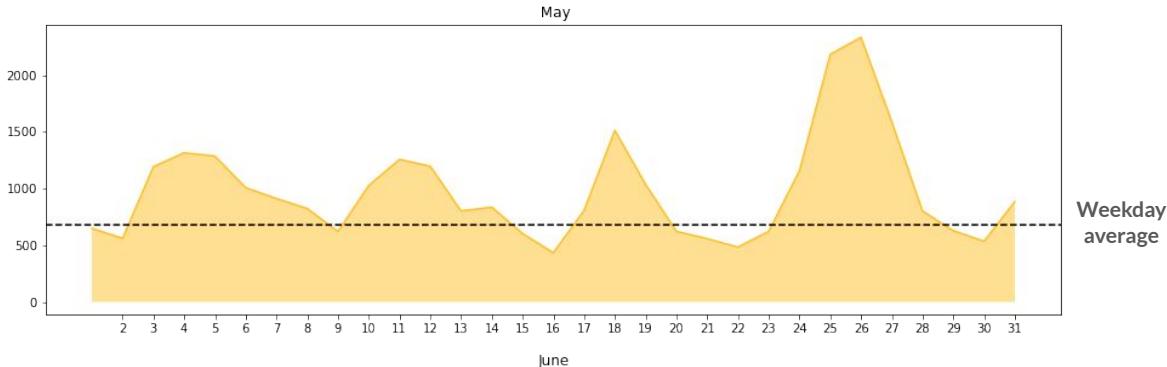
Number of Scooters Per Day with 3+ Trips

- KPI = 3 trips or more
- Weekends vs Weekdays vs Holidays/Events



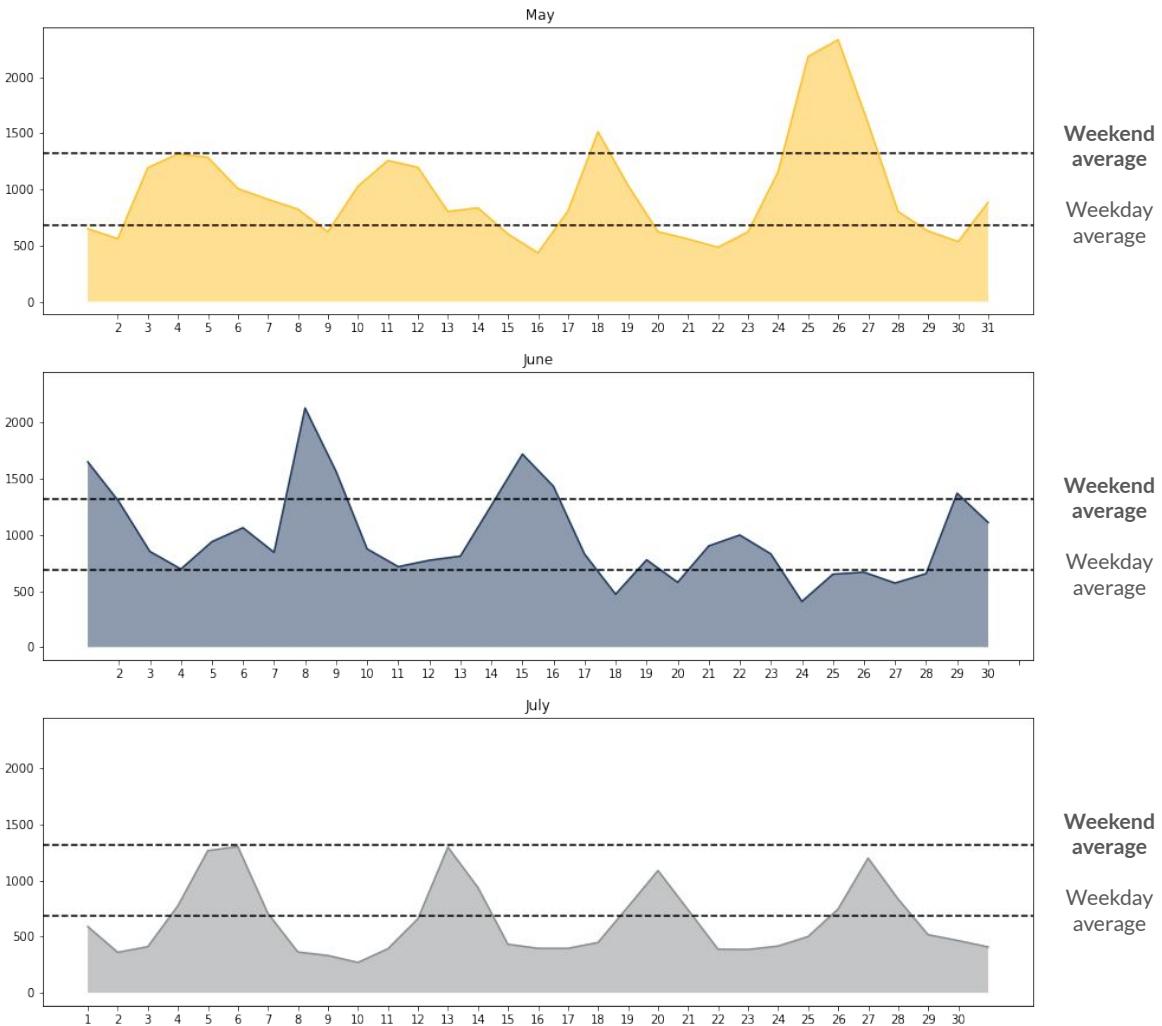
Number of Scooters Per Day with 3+ Trips

- 684 scooters on average per weekday



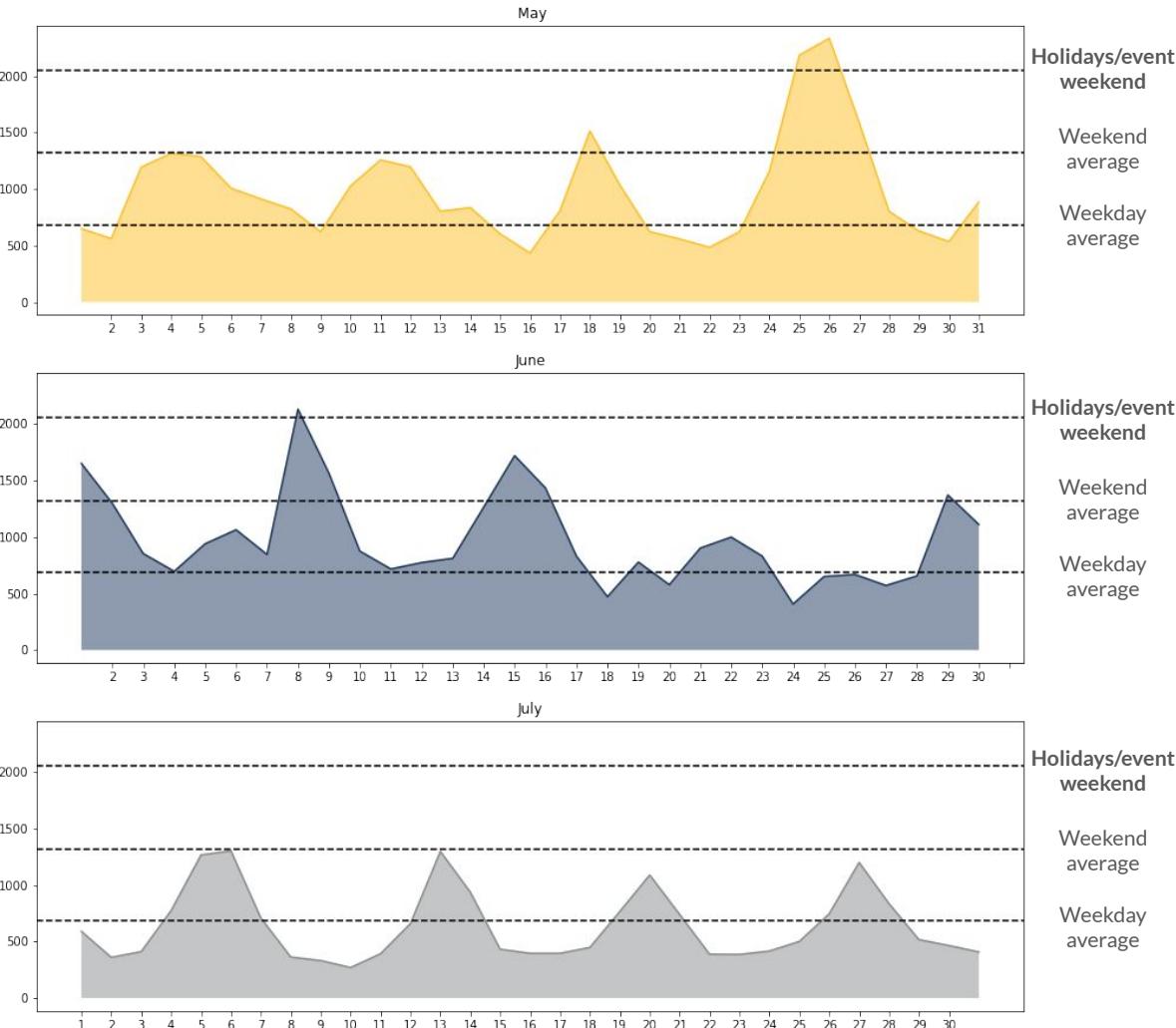
Number of Scooters Per Day with 3+ Trips

- 684 scooters on average per weekday
- 1,320 scooters on average per weekend day

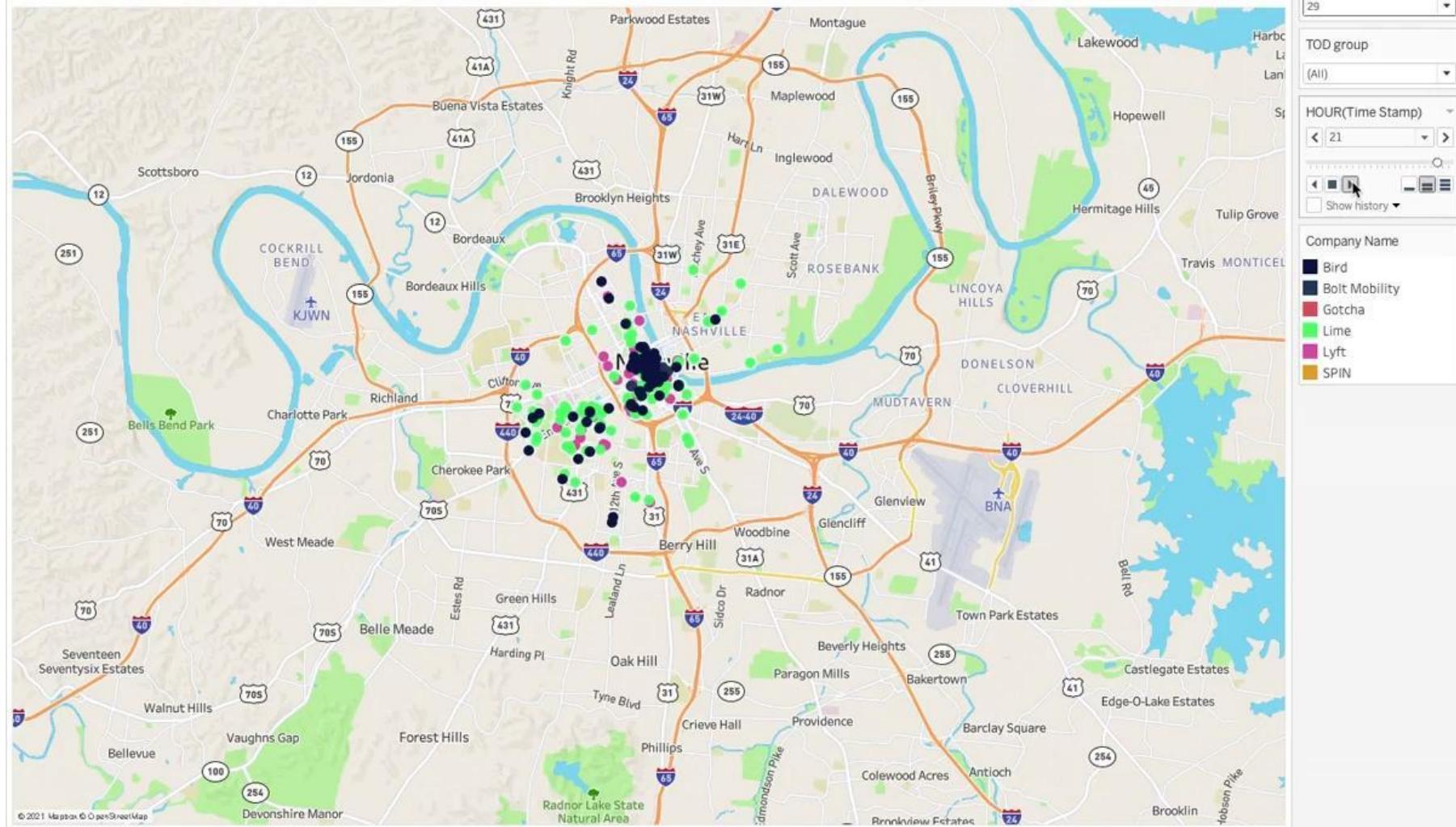


Number of Scooters Per Day with 3+ Trips

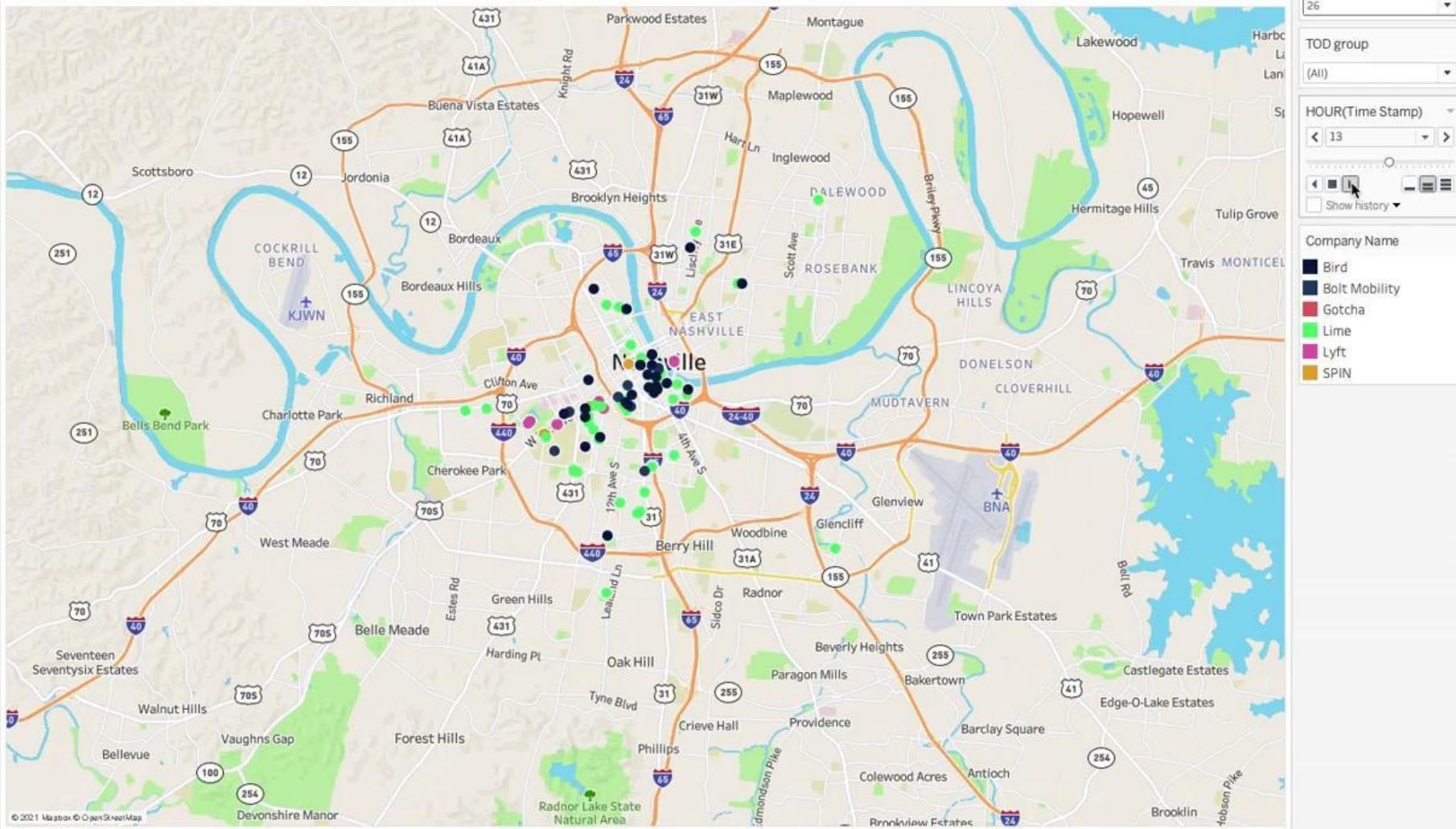
- 684 scooters on average per weekday
- 1,320 scooters on average per weekend day
- 2,053 scooters on average per holiday/event weekend day



Scooter Start Locations



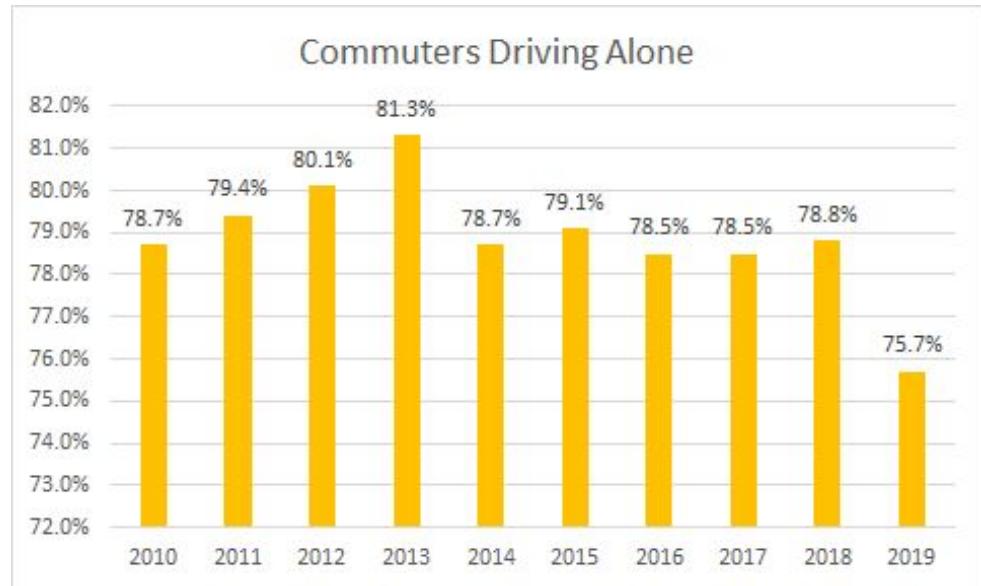
Scooter Start Locations



Notable Factors

The Big Picture

- Nashville is dominated by commuters driving alone
- The average travel time to work is 24.9 minutes into Davidson County
- The average scooter trip duration is between 5-10 minutes

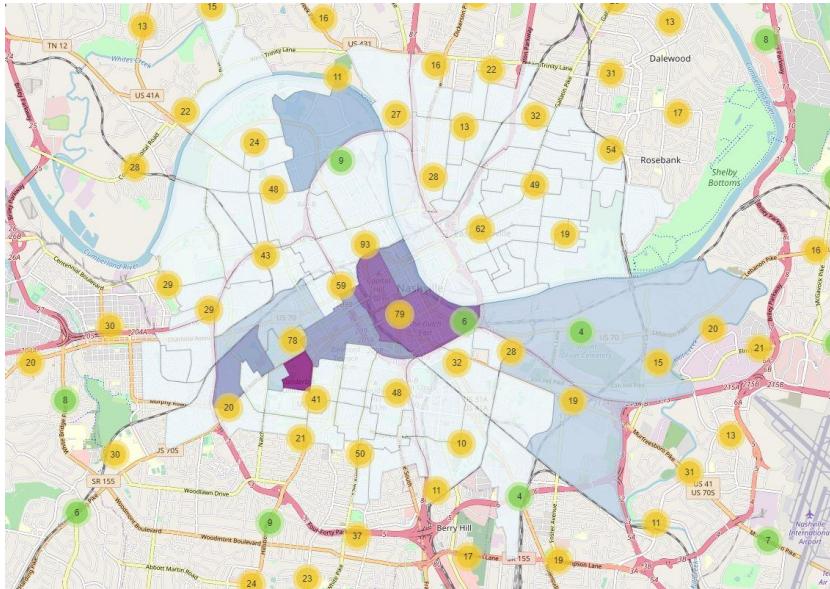


The Big Picture Text

- The primary transportation goals that this analysis focuses on are connectivity to other transportation modes and jobs, and an indicator for this ideally being a reduction in the number of people driving alone. While this has lessened some over the last 5 years, it's still a huge portion of how people commute. The largest hit to commuters driving alone over the past decade has been an increase in those working remotely. No other modes meaningfully shift.
- The trip times tell us that people aren't replacing their car commutes with scooters and reinforces the "last mile" narrative.

The Last Mile

How can commuters use scooters to solve the last mile problem?



The Last Mile Text

The last mile problem is a term that refers to that last mile, for example, between a bus stop and your job, or a hospital, or a school. How can that last mile be closed? SUMDs have been proposed as an ideal solution. Is this how they're being used? Is their ideal distribution so that they're not piling up on sidewalks?

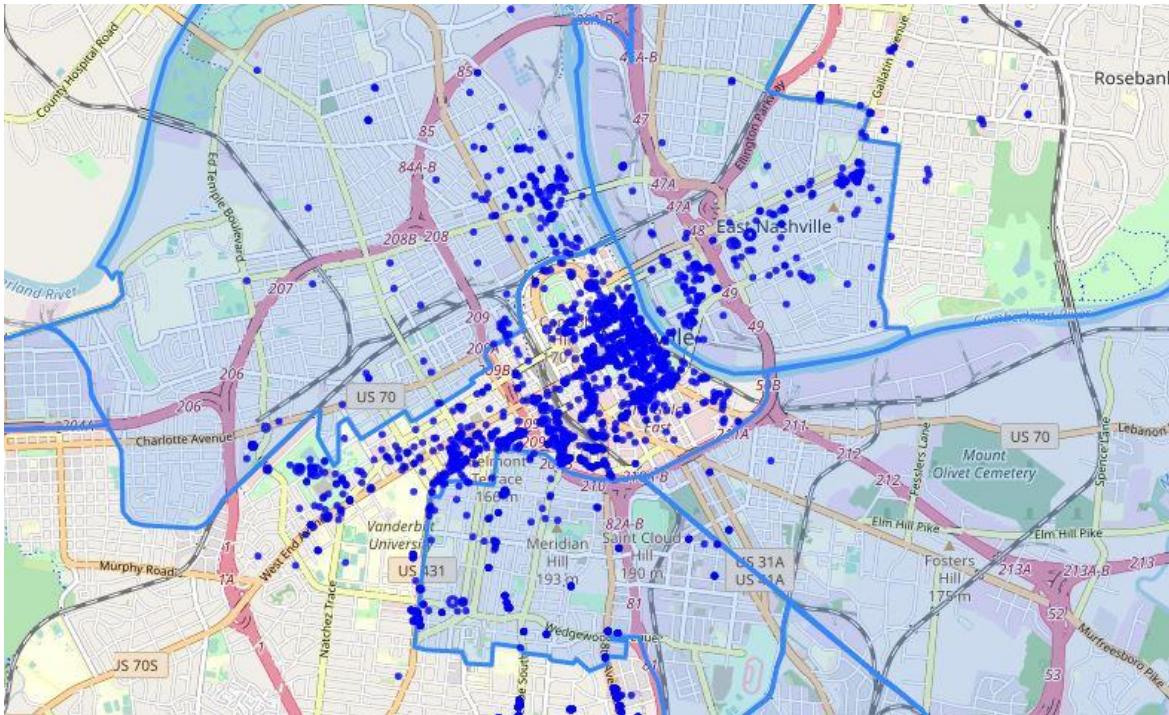
This map shows the density of jobs by census block downtown, as well as the number of bus stops. It's clear where people need to be able to connect to with these scooters to get to their jobs. Most scooters are ridden greater than 140 times per month downtown surrounding Broadway.

However, there's conflation with the jobs and bus hotspots and nightlife hotspots. With an implication that riders may be impaired and that these may be tourist rides rather than resident rides, we're not able to rate how these scooters are meeting laid out transportation needs. To be clear we do want to serve both residents and tourists, but the needs may be different.

However, we can consider the time of day that the most scooter rides are being rented, you can get a better idea of how they're being used downtown. The light blue line is the block of time bookending a typical workday. We do see that more people are renting these scooters on both weekends and weekdays around 3 - 8 PM. Again, this is both happy hour and the end of the workday.

The Promise Zones

HUD designated areas that are experiencing relative socio-economic depression



- Specifically, how are they acting as a means of transportation in the Promise Zones?
- This map shows start points at the beginning of a day that was found to be average in terms of ridership in May. We can see that the most promise zone utilization is in East Nashville, but North and South of downtown show room for improvement in terms of getting more ridership and making more well-charged scooters available to the populations there.

Our Recommendation

Recommendations

- Total Scooter Fleet Size limit by week/weekend:
 - Weekday: **947**
 - Weekend: **1744**
 - Holiday Weekends: **2389**
- Max Scooter density:
 - Weekday: **237**
 - Weekend: **436**
 - Holiday Weekends: **597**
 - This is dynamic density to account for surges in tourist-related days
 - Downtown has highest demand for scooters.
 - ZIP codes: 37201, 37203, 37219

Q & A