

Atlanta's Pandemic-Related Rail Transit Changes

Georgia Institute of Technology, Atlanta, GA
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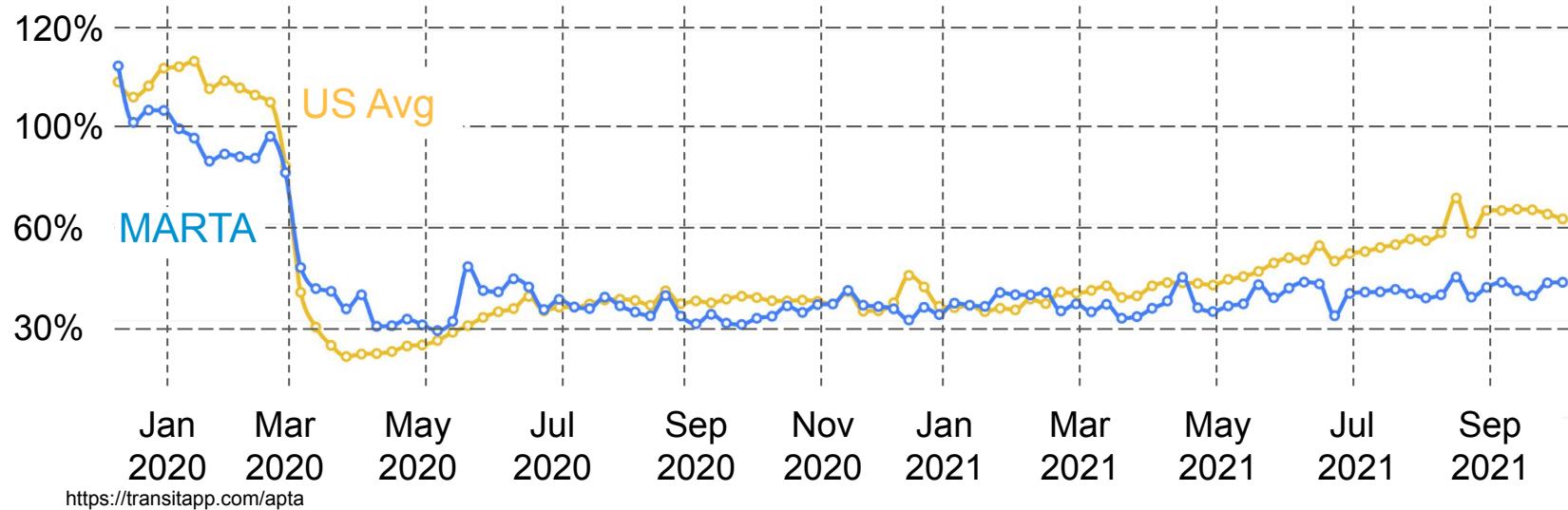


Research Objectives

1. Quantify ridership change
2. Extract potential equity impacts
3. Provide recommendations

Transit Since Pandemic

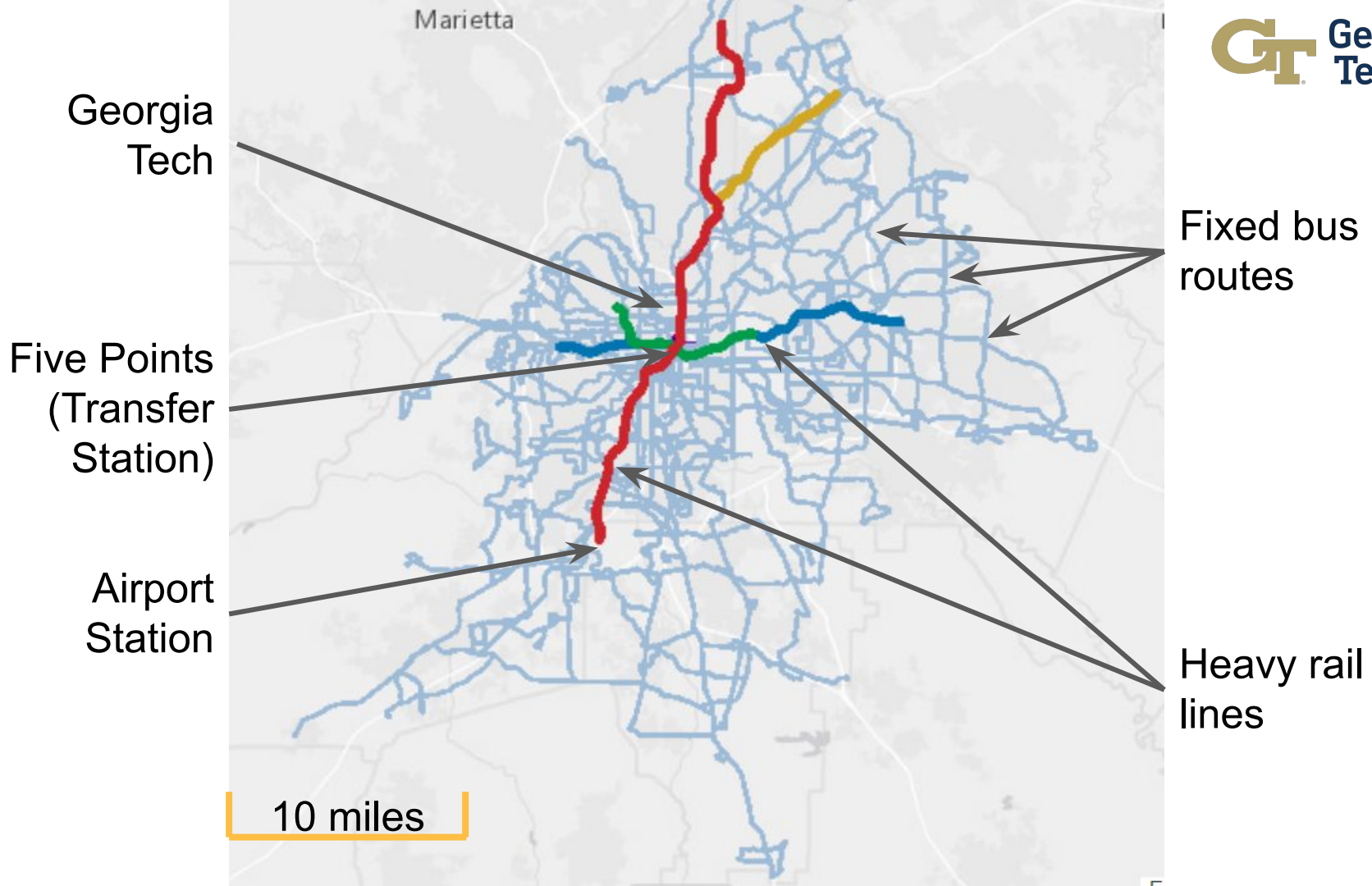
All-modes transit ridership over course of COVID-19 pandemic



MARTA's heavy rail ridership fell **over 70%** at the start of the pandemic, with **slower recovery** compared to other systems

Timeline of Operational Changes

- **March 13, 2020** - MARTA GM commits to safe transit and continued service
- **March 26, 2020** - MARTA suspends bus fares
- **March 30, 2020** - Rail and bus service reduced
- **April 16, 2020** - Bus and rail service declined by 40% and 80%, respectively
- **April 20, 2020** - Service halted on 76 (of 110) bus lines
- **April 24, 2021** - MARTA restores pre-pandemic service on all bus routes



Stakeholder Characteristics

- **Atlanta 2010 Poverty Rate:** 12.1% in MARTA service area
 - As high as **53.2% in poorest station census tracts**
- **2010 median family income** \$68.3k/year
 - **Highest census tract:** \$195k/year
 - **Lowest census tract:** \$12.3k/year
- **Transit ridership decline:** 10.3% to 3.7% over 40 years (1970 to 2010)
- **White population share** down from 74.7% to 52% in MARTA service area

Data from US Decennial Census of census tracts containing stations (eg, Vine City, Bankhead)

Transit Dependency

FTA Transit Dependent Definition - any of:

- Below census tract median income
- Elderly (65+)
- Legal minor (younger than 18)
- Non-vehicle household resident

For this project, *low income households* will be a focus

Data Sources

- **ARC On-board Survey** for pre-pandemic demographic data
- **AFC BreezeCard logs** for ridership metrics by fare collection
 - Calculated anonymized link and station ridership
- **General Transit Feed Specification (GTFS)** for schedules and stop locations
- **ARC MARTA route and stop shapefiles** for mapping and visualization

Methodology for Quantifying Ridership Change

Data Cleansing



Midtown  Entry @ 12:00

**Trips provided for first week of
May in 2019, 2020, and 2021**

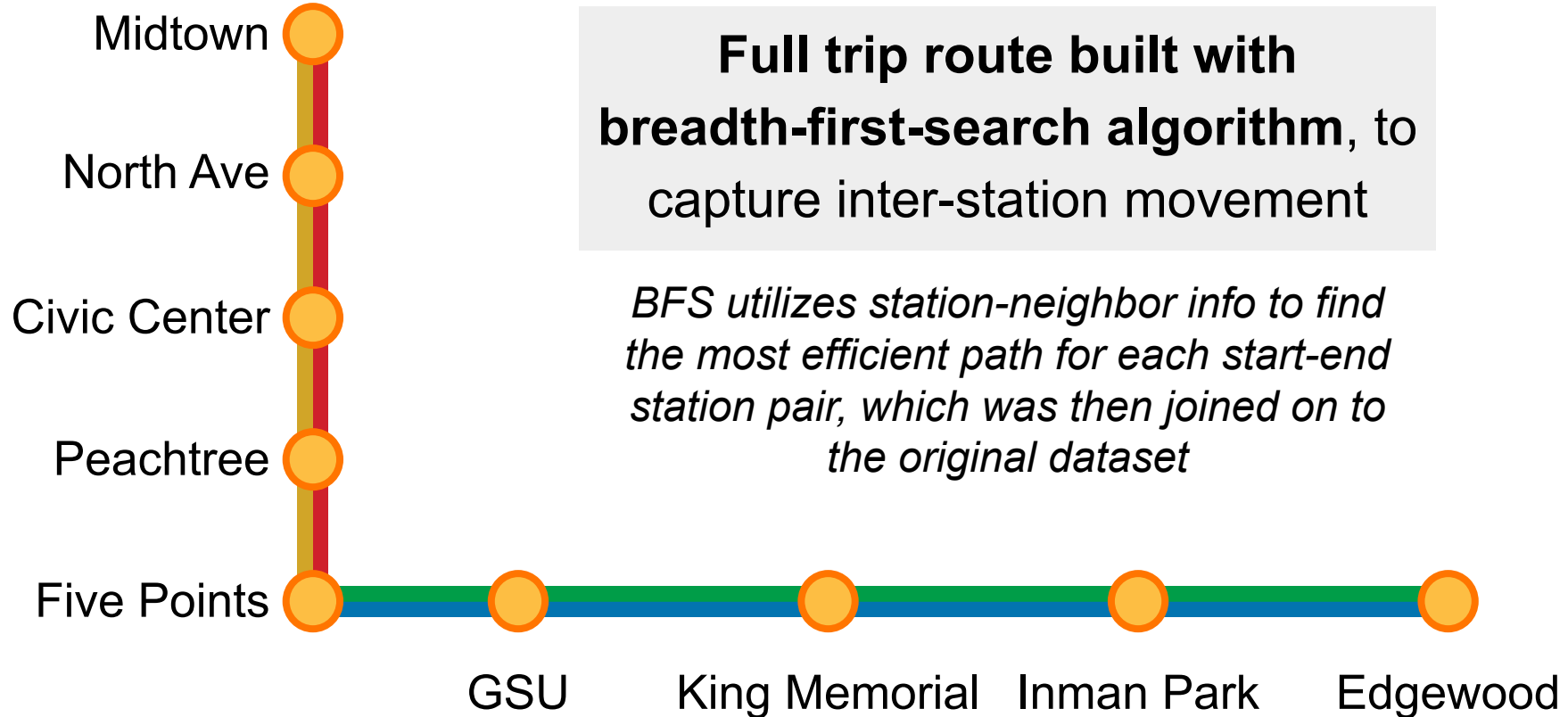
**AFC BreezeCard data provided
info on ~1.5M trips, including
start and end station and time**

**9% of trips were dropped for missing
start or end information*

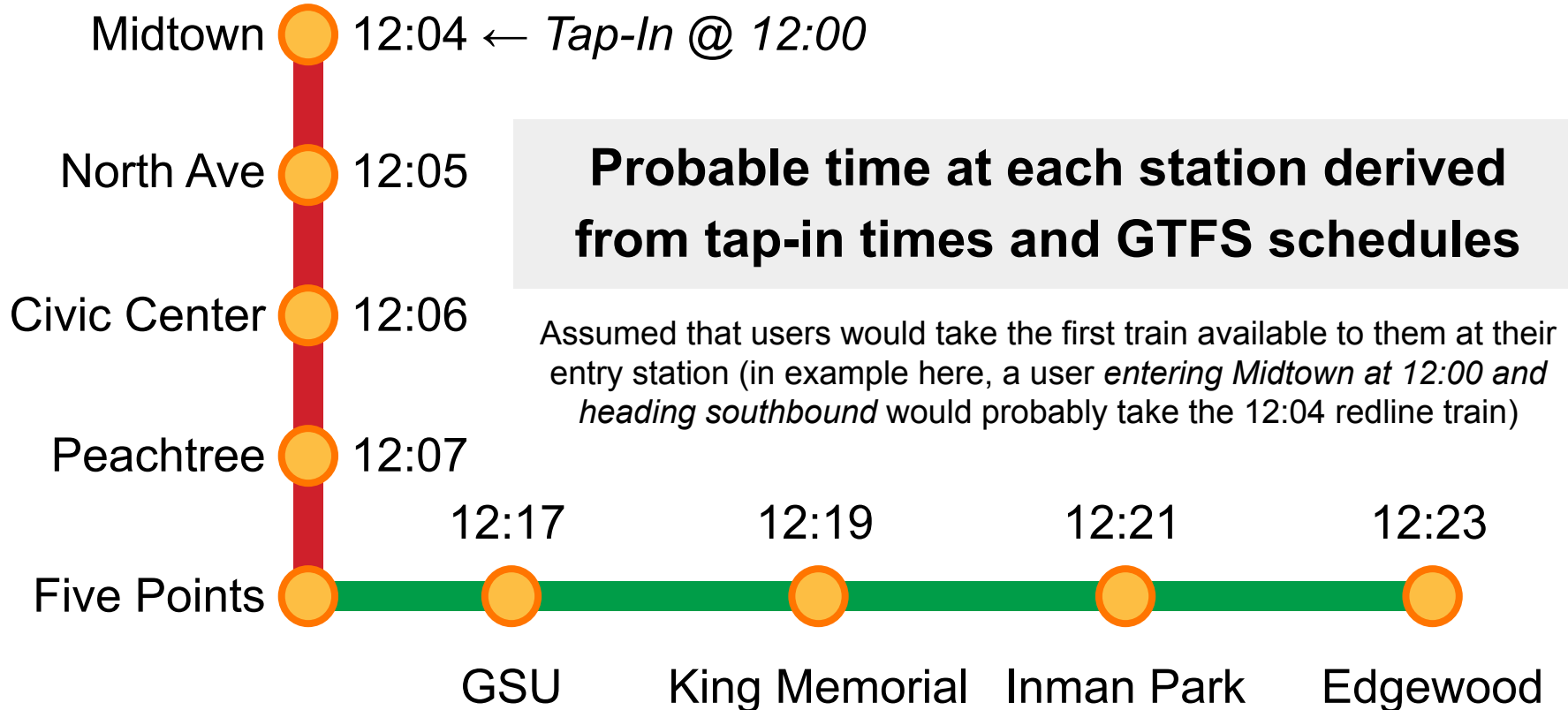
Exit @ 12:30


Edgewood

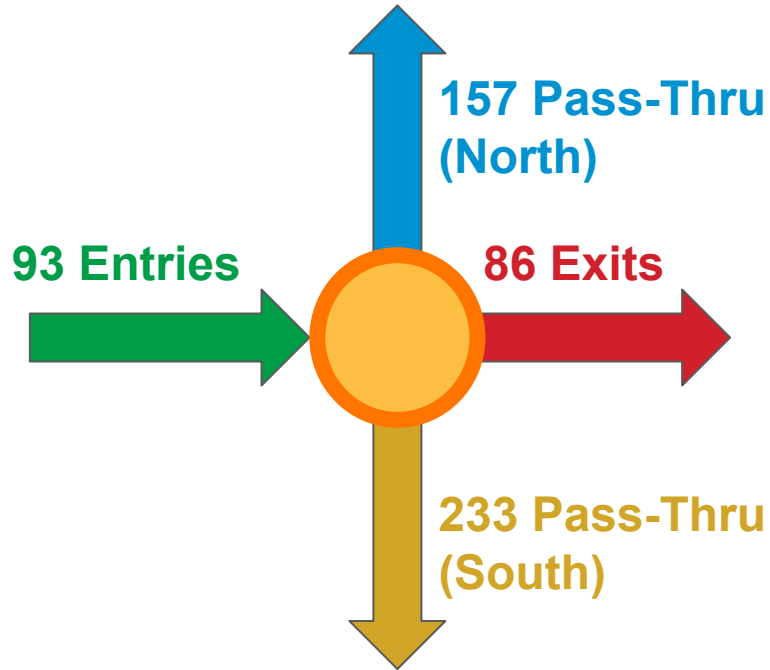
Building Trip Routes



Joining Schedules



Aggregating Data

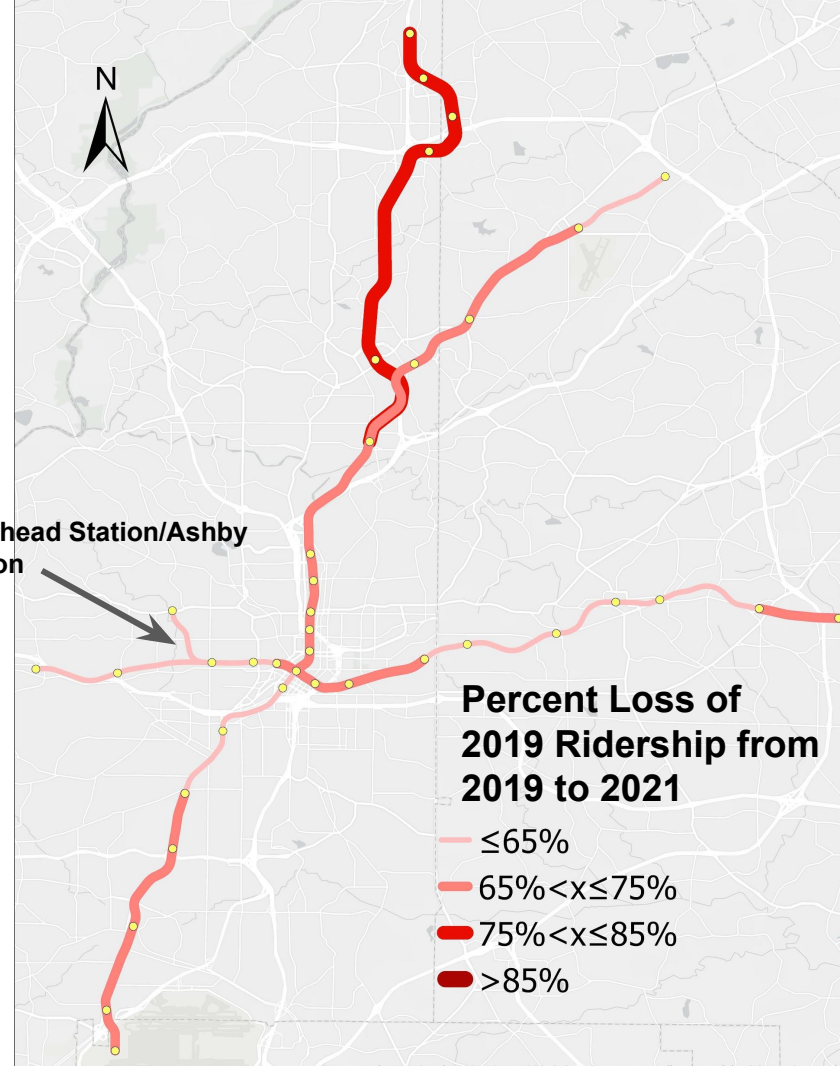
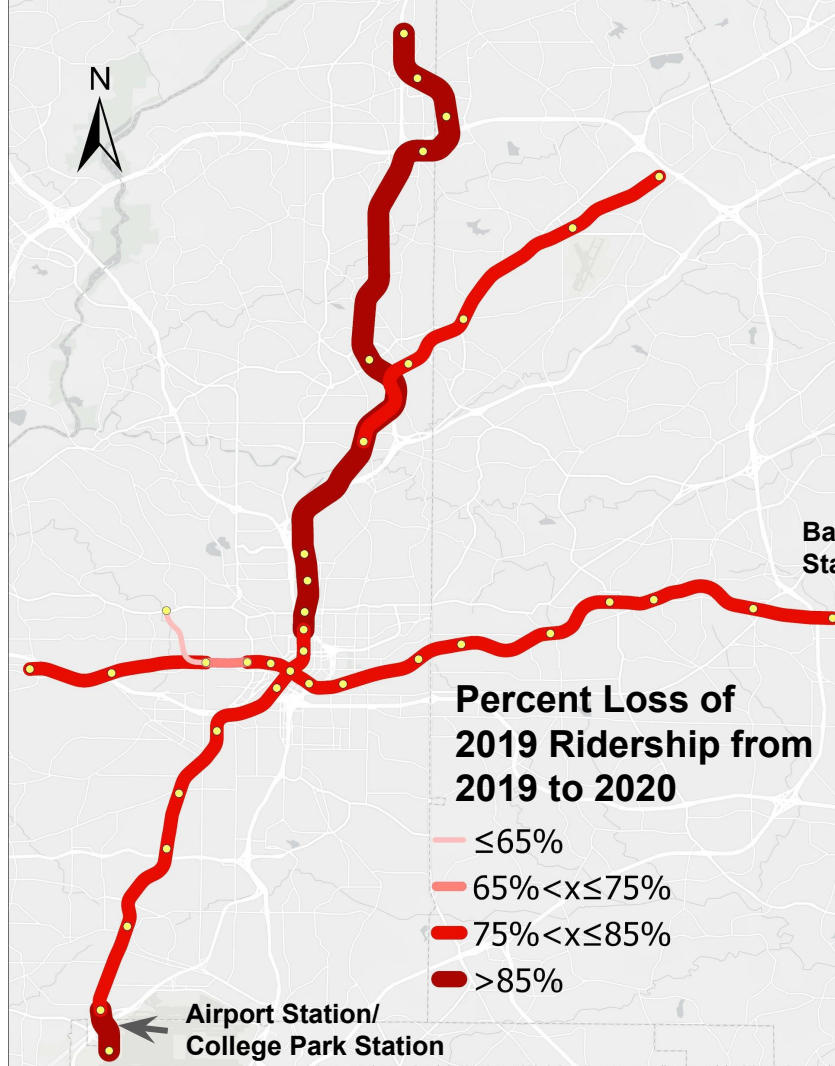


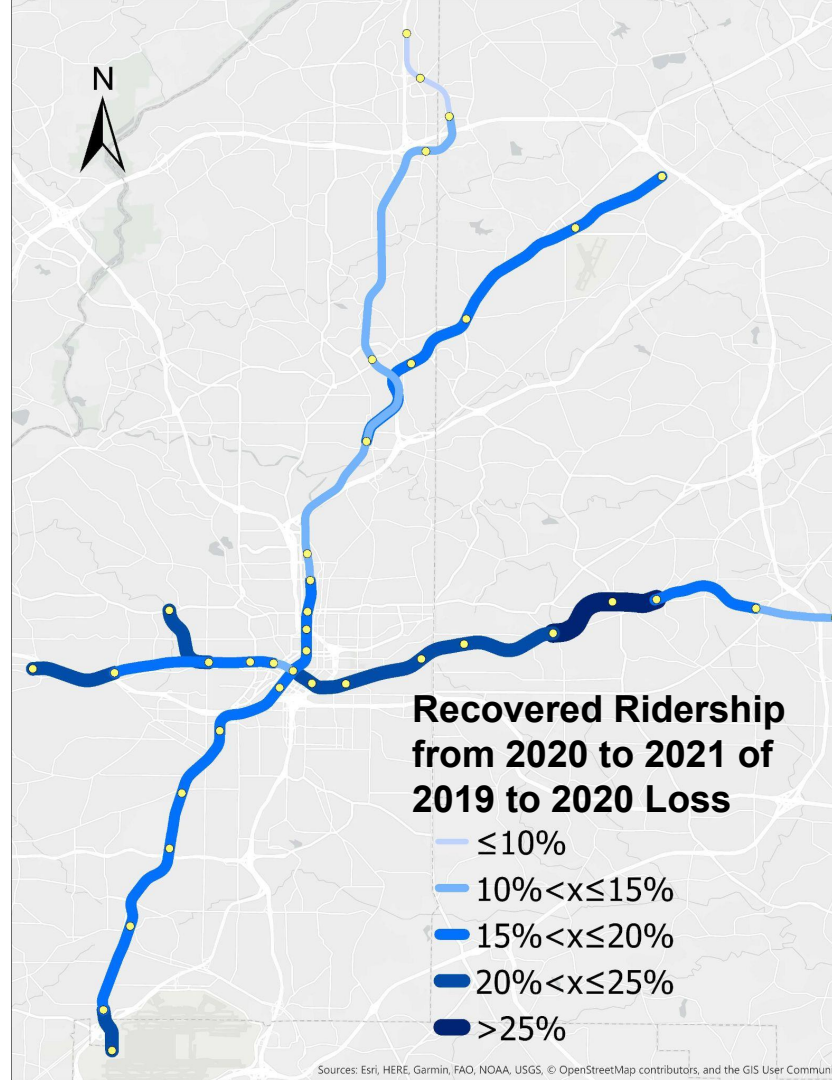
Midtown Station on
Thursday @ 12:00 - 12:59

Passenger counts aggregated
by *hour*, *day*, and *action* to
quantify total ridership trends
at each station, including
entries, exits, and pass-thrus

Data shown here is illustrative, but is available for all
stations and for all time windows, allowing for
comparison *across years*, as shown in the maps on
the subsequent slides

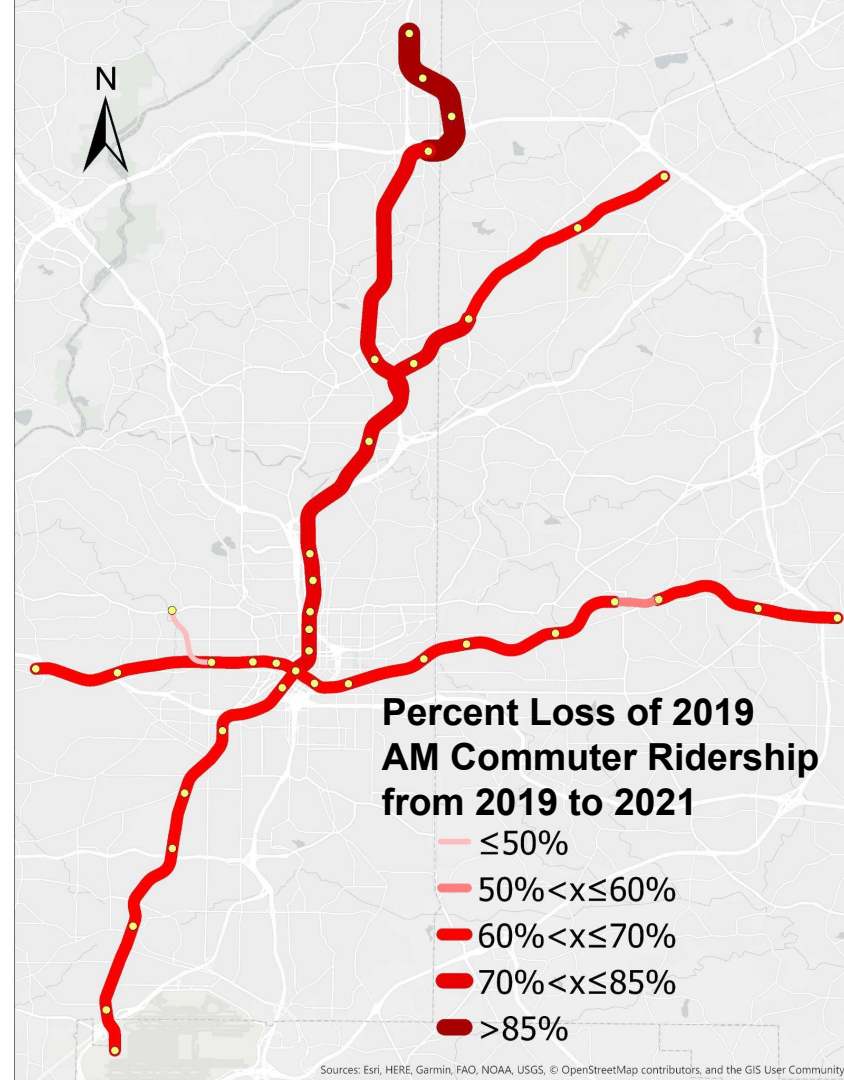
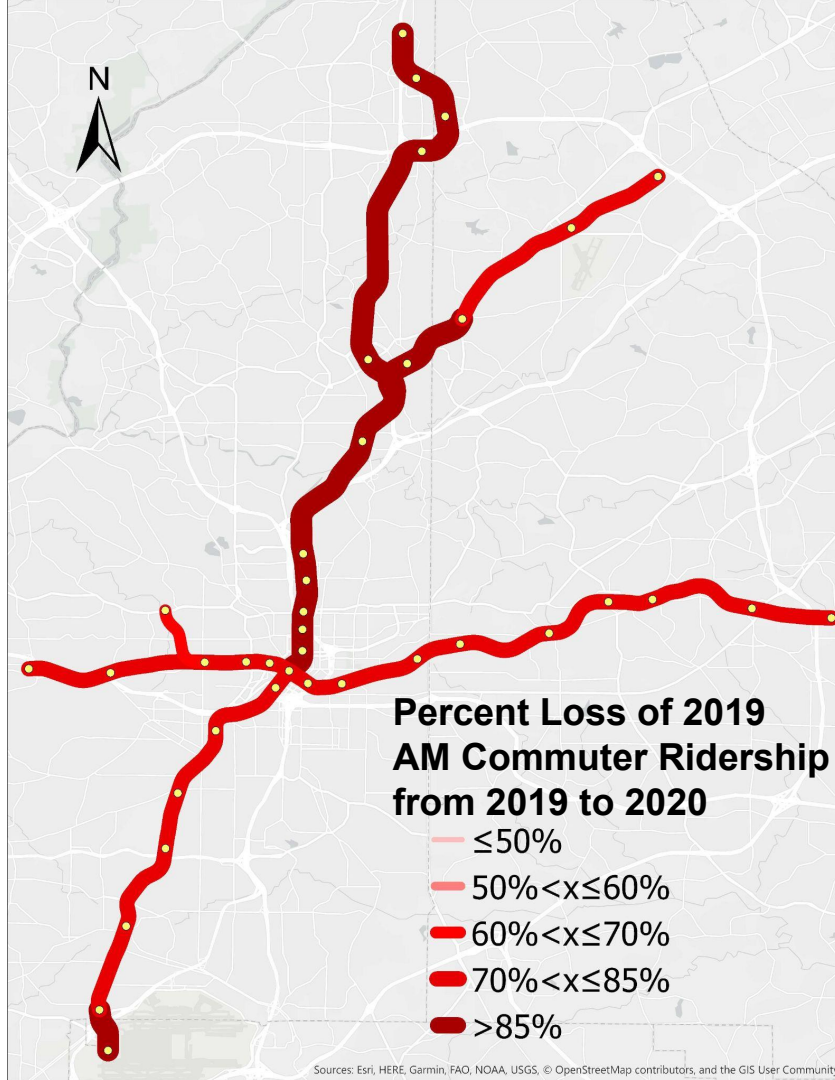
Percent Change in Link Load from 2019 to 2020 and 2021

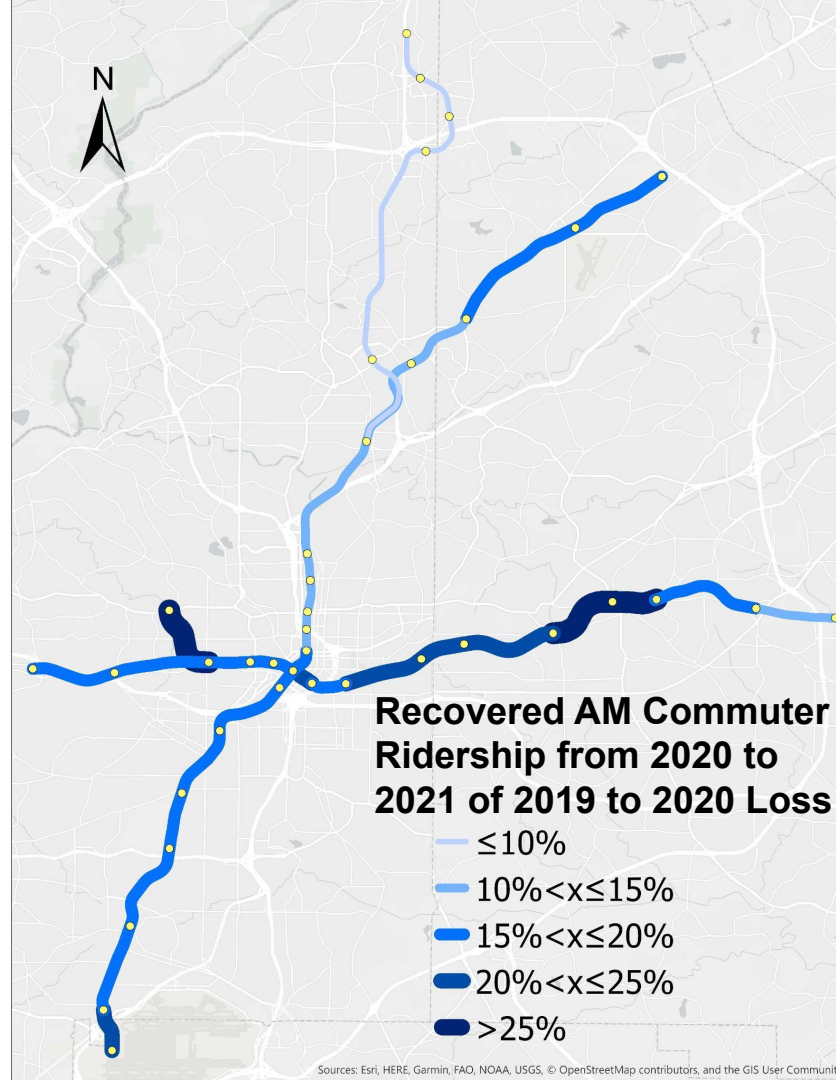




Percent Change in Link Load

During AM Commuting Hours Only



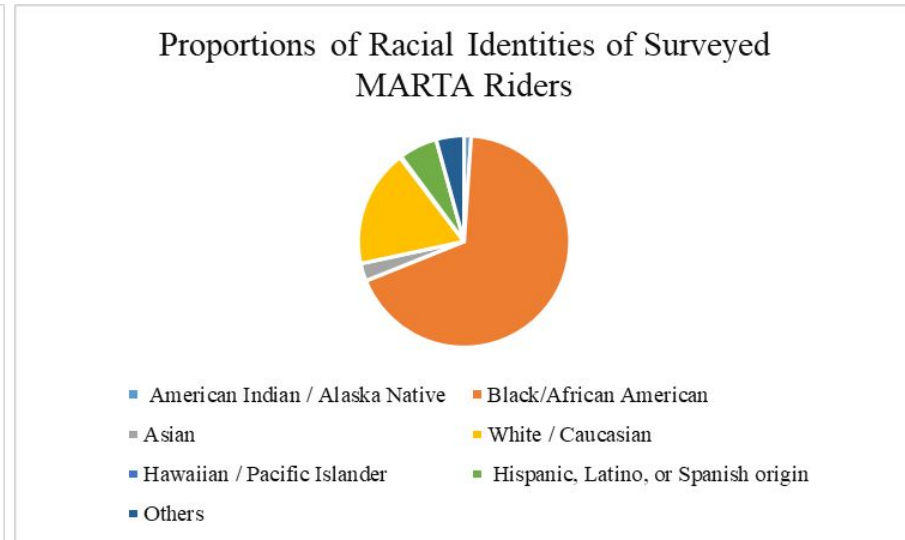
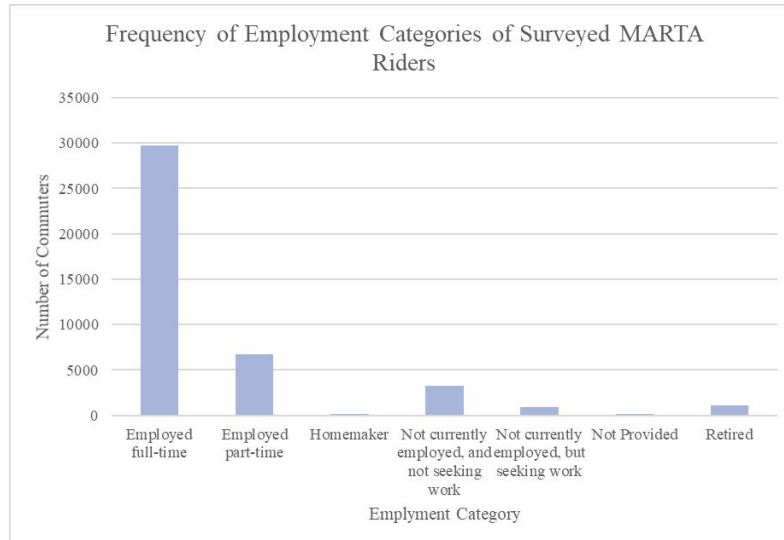


Extracting Equity Impacts

Socio-demographic Characterization

Socio-demographic variables from *2019 ARC On-board Survey* data used to graph rider characteristics

- *2019 demographic data was compiled by start station and then linked to pandemic change in ridership at a station level*



Socio-demographic Multivariate Regression

Variables used to pretest the model:

Independent

- Ratio of Different Race
- Ratio of Different Employment Status
- Number of Private Vehicles
- Household Size
- Income
- Gender
- Days Travelled

Dependent

- Percent change in ridership from 2019 to 2020

Diagnostics used to Modify the Model:

- Multicollinearity
- Outliers
- Heteroscedasticity

Socio-demographic Multivariate Regression

Final Regression Model Included:

Independent

- “Ratio of African-American riders”
- “Average number of full time employees”
- “Average number of private vehicle owned”
- “Ratio of female riders”
- “Income Range”, etc.

**Variables tested
and filtered** following
correlation and
significance issues

Dependent

- “Percent change in ridership from 2019 to 2020”

Multivariate Regression Results

All-day ridership:

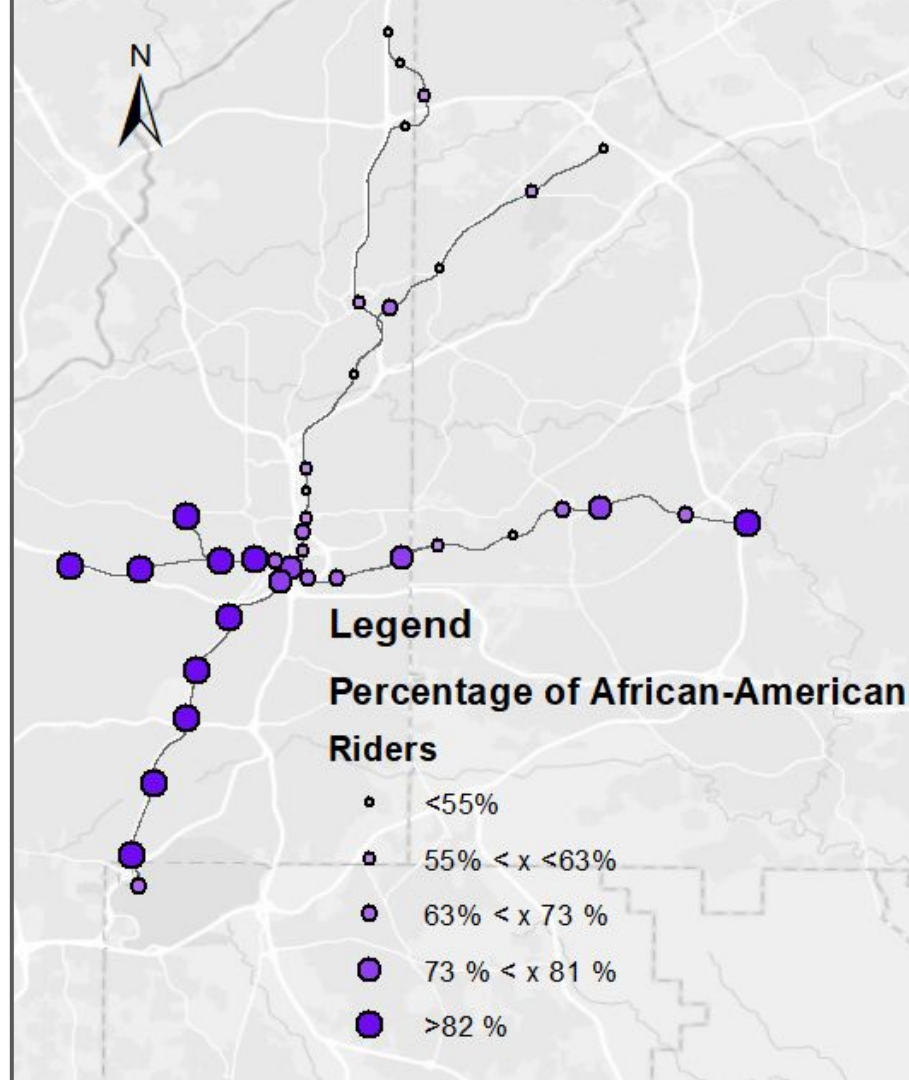
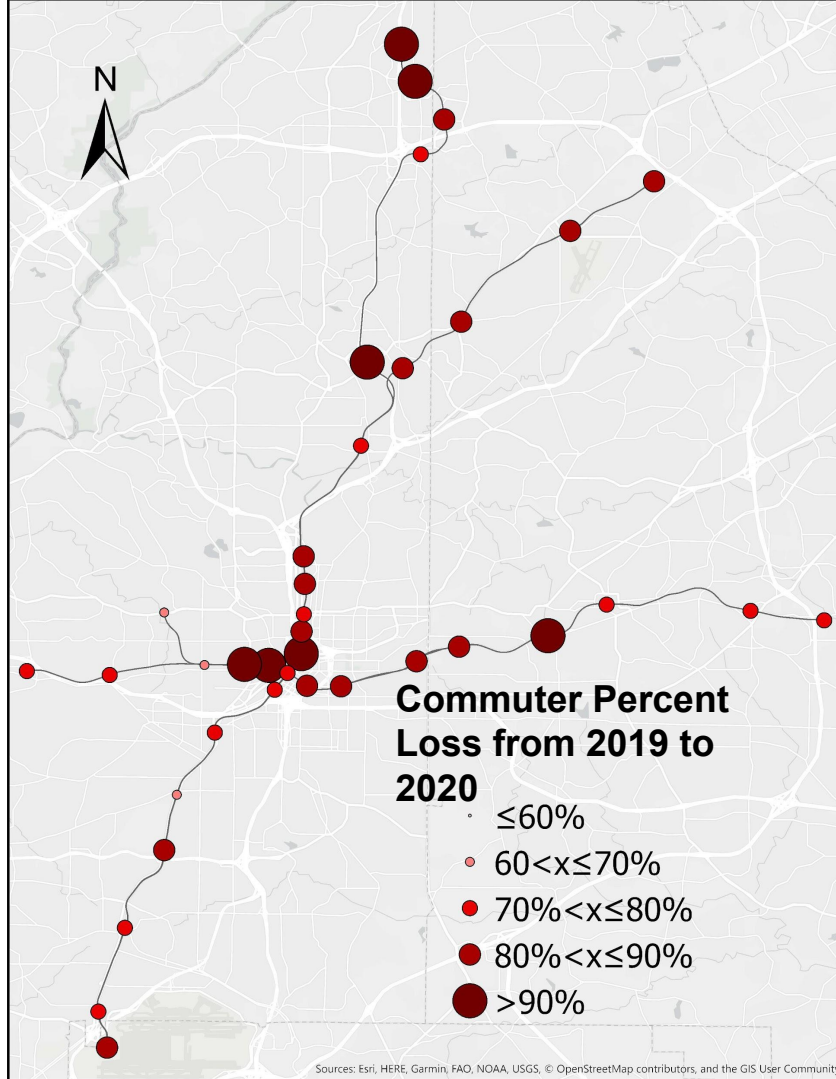
- 35 of 38 stations valid
- Adjusted $R^2 = 0.3693$
- Significant coefficients:
 - African-American rider proportion
 $p = 0.088$

Poor correlation, but
unexpected ridership profile

Refine data and retry

Peak hour (6 AM - 10 AM):

- Adjusted $R^2 = 0.6181$
- Significant coefficients:
 - Median-income range
 $p = 0.022$
 - Mean Household size
 $p = 0.020$
 - Mean Household Vehicle count
 $p = 2.7 \times 10^{-4}$
 - Full-time Employment ratio
 $p = 0.030$



Conclusions, Limitations, & Recommendations

Conclusions

- **Most significant losses** on northern portions of network along Red and Gold lines

- Associated with higher income and greater white pop share

- **Most ridership retained** on Green and Blue lines and service area south of Five Points

- **Significant correlation** between overall per-station ridership declines and percent African American riders

- **Significant correlation** between commuter per-station ridership declines and median income, household size, household vehicle count, & full-time employment ratio

Recommendations - Normal Operations

- **Preserve sections critical to transit-dependent riders,** especially Green/Blue and southern Red/Gold lines

- **Improve bus connectivity** to same rail sections

- Consider flexible routes to adapt to stakeholder needs

- **More comprehensive on-board surveys**

- Add educational level / employment type / housing type / % unemployed

- **Standardize language in data records** (e.g. station names should be the same across AFC, ARC Survey, and GTFS)

Recommendations - Stressor Scenarios



Prioritize stations serving dependent riders

→ Least likely to cope under disaster conditions



Repurpose on-demand mobility for small-group transport



Appeal for emergency funds to avoid need to cut service or raise fares

Limitations

- **Ridership-socio-demographic correlation inferred from 2019 on-board survey data** - exact relationship uncertain without longitudinal on-board survey data throughout the pandemic identifying what groups left MARTA

- **Survey data** only usable from 2019
 - Unemployment surge following lockdown unavailable
 - Disaggregate education data not available

- **Incomplete AFC responses** not included in analysis (~10%)

- **Post-vaccination-campaign data** not available for analysis

- **Multimodality of ridership** could not be deduced from data

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