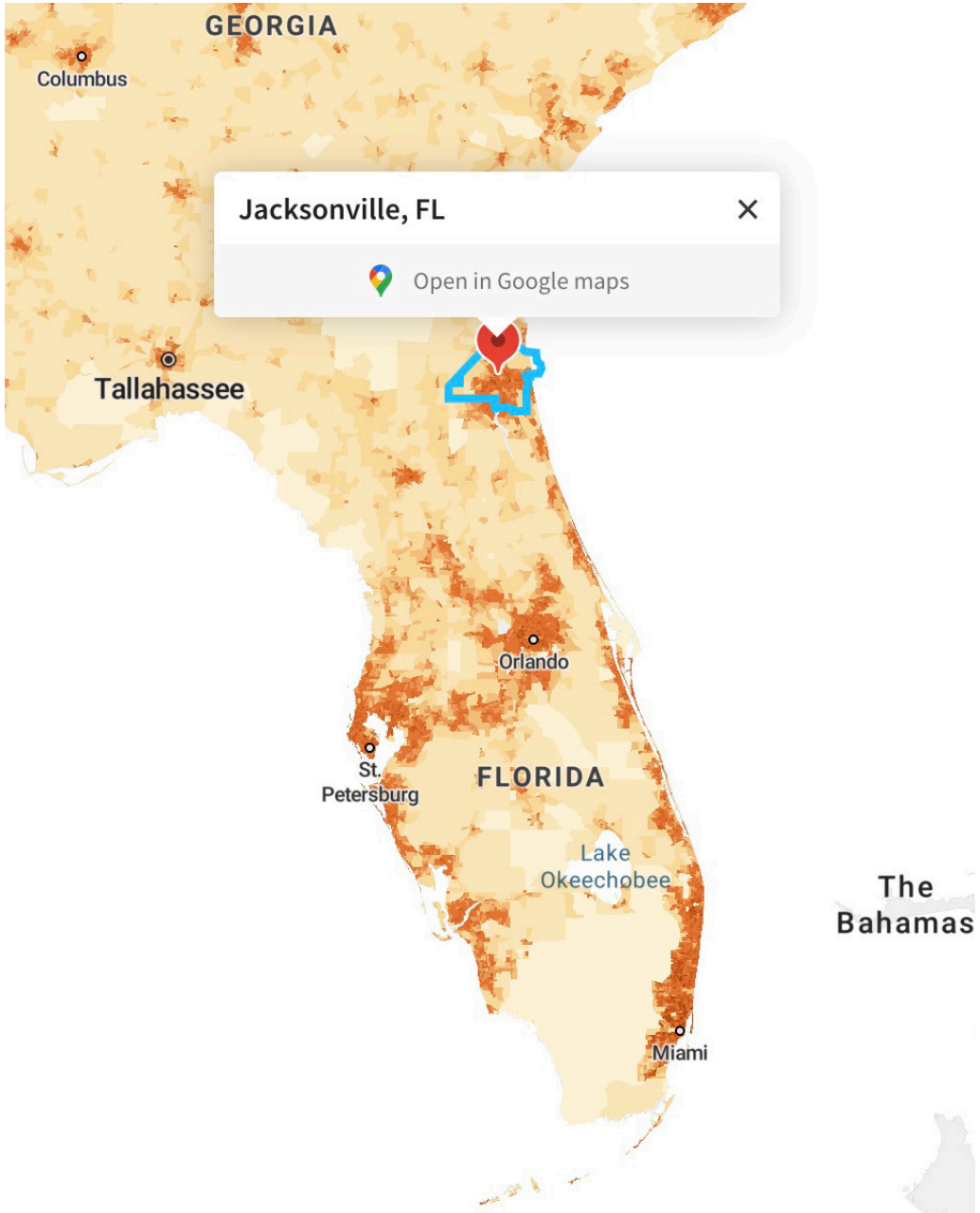
# A01. Overview

The Jacksonville Metropolitan Area (JMA), located in the north-eastern part of Florida, includes Duval, Clay, Baker, Nassau, and St. Johns counties. JMA covers a land of 3,202 square miles, centered on the principal city of Jacksonville (767 square miles), Florida. The Jacksonville metropolitan area is the 40th largest in the country and the fourth largest in the State of Florida, behind the Miami, Tampa, and Orlando metropolitan areas.




Fg1. Location of Jacsonville Metropolitan Area (© Social Explorer)

# A02. Zonal Statistics

## Household Characteristics

### Household size

In total, there were 168,974 1-person households, 210,165 2-person households, 99,428 3-person households, and 124,738 households of 4 or more people.

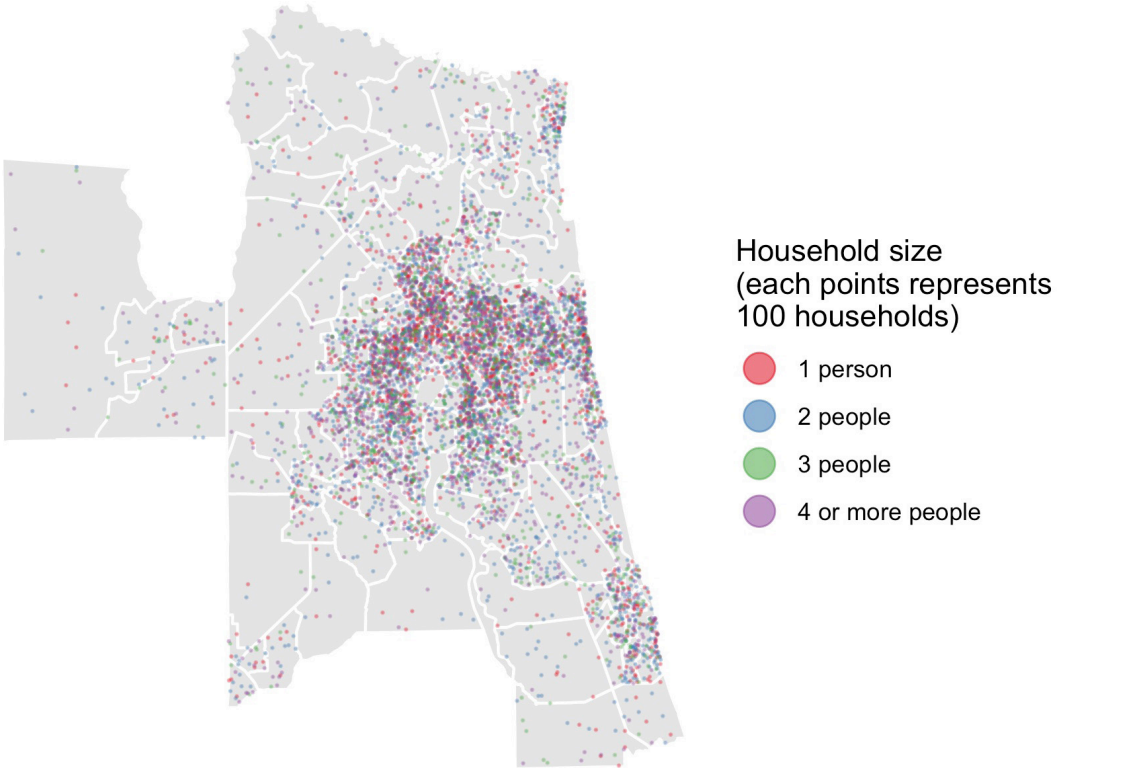
With an average size of 2.5 persons per household. 50% of the population 15 years and over were married.

### Household vehicle availability

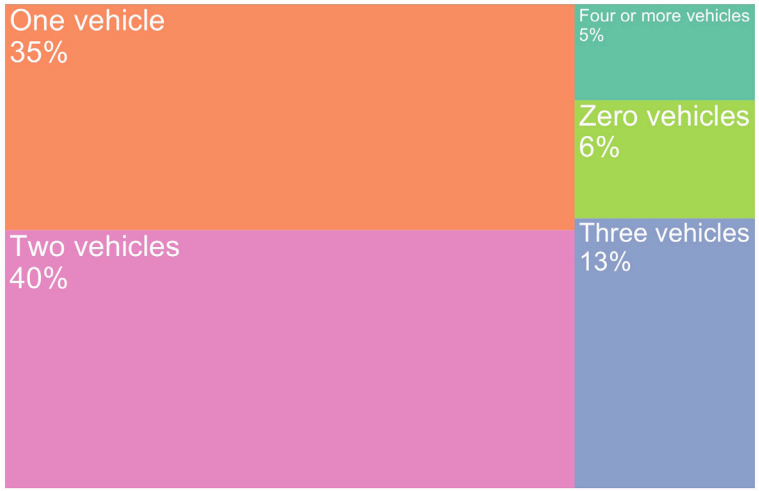
As a sprawling city, walking and bicycling are not popular modes of commute in JMA. According to the 2021 ACS 5-Year Estimates, 35% of total households owned one vehicle, 40% owned two vehicles, 13% owned three vehicles, and 5% owned four or more vehicles.

There were 34,827 households in possession of no vehicle, around 5.8% of total households. On average, each census tract had around 102 families without vehicles. The median of households without vehicles was 65, and the histogram was very right-skewed. Census Tract 6 in Duval County had the greatest number of households without vehicles, 754, which was around 31% of total households living in this tract.

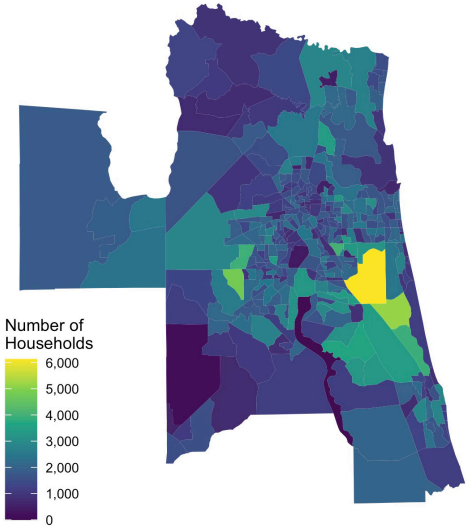
The average travel time to work in 2021 was 25.3 minutes. 71% of workers 16 years and older drove alone to work, 18% worked from home, and only 8% carpooled. Due to the low population density, the city sustains a low level of travel congestion, but also suffers from an undeveloped mass transit system.

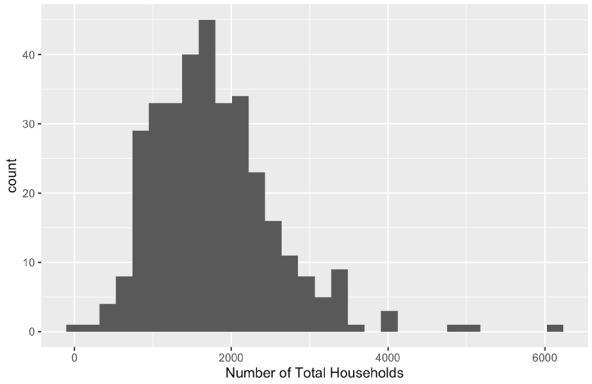



Fg2. Household size

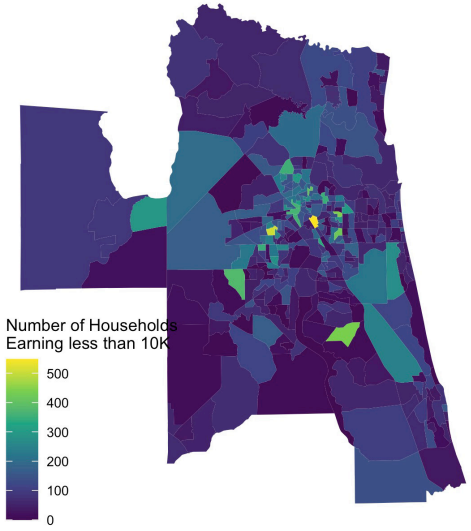


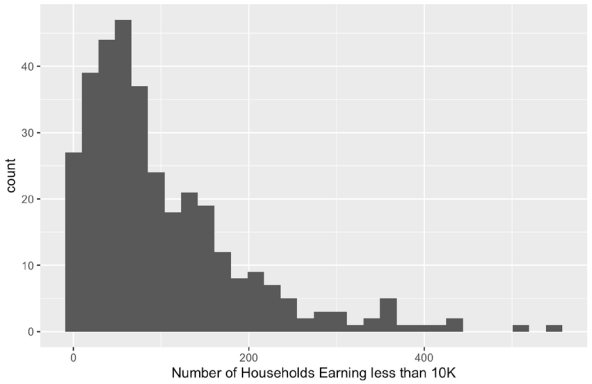

Fg3. Household vehicle availability



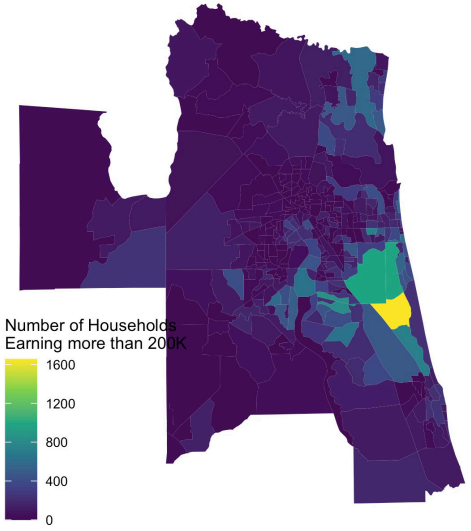



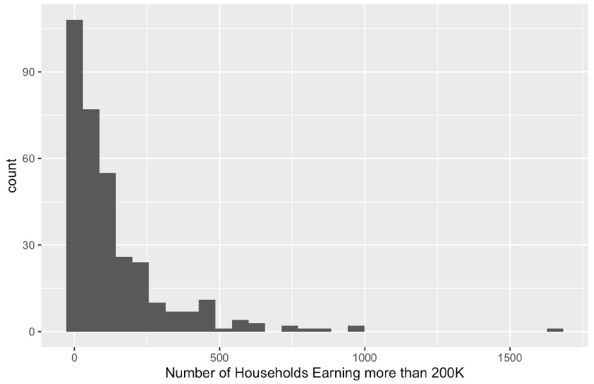

Fg4. Total number of households




Fg5. Numer of households earning less than 10k




Fg6. Numer of households earning more than 20k

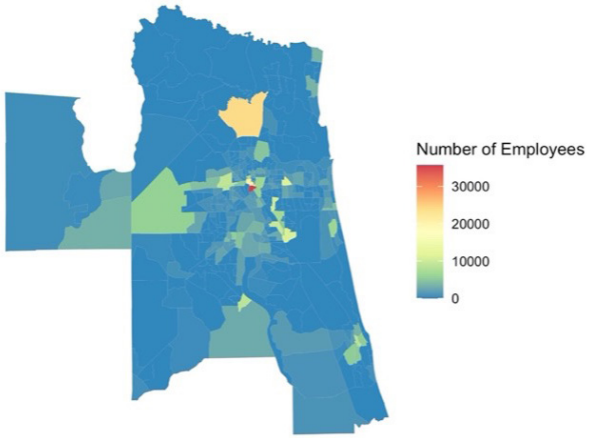
**Total number of households**

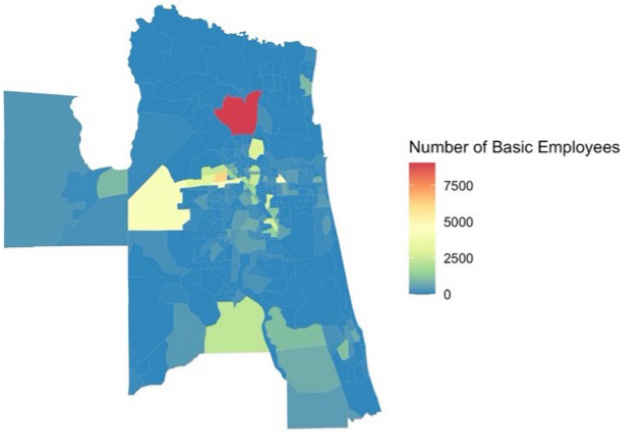
According to the 2021 American Community Survey 1-Year Estimates, there were 603,305 households in total. On average, each census tract had around 1775 households. The median number of households was 1,696. Census Tract 144.23 in Duval County had the greatest number of households, 6,129.

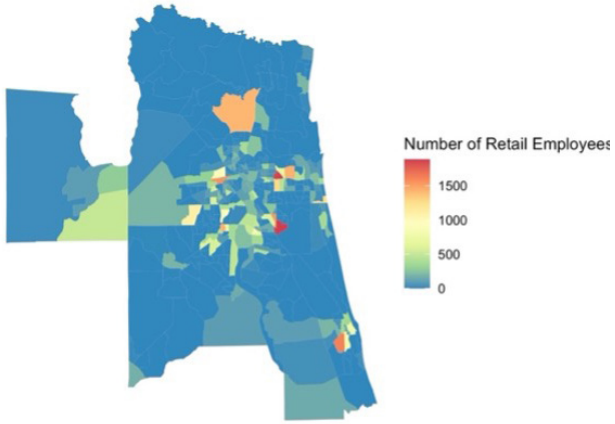
**Household income**

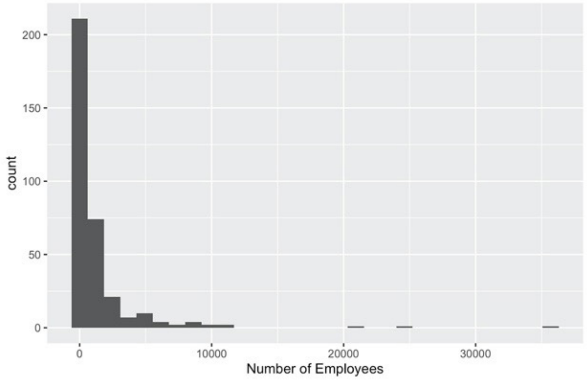
There were 34,272 households with an annual income lower than 10k, which was far below the poverty line. On average, each census tract had around 101 households earning less than 10k. The median number of households was 72. Census Tract 6 in Duval County had the greatest number of households whose income was lower than 10k, 548.

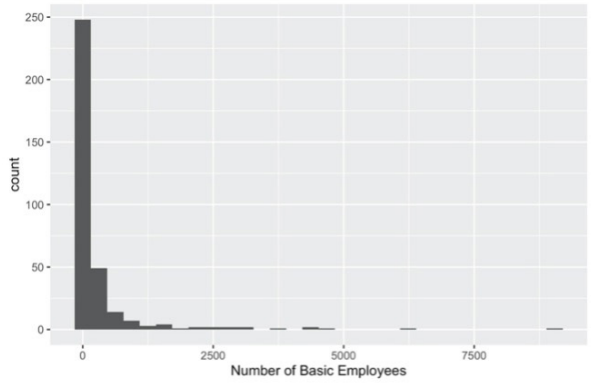
There were 45,679 households with an annual income greater than 200k. On average, each census tract had around 134 households earning greater than 200k. The median number of households was 72. Census Tract 206.05 in St. Johns County had the greatest number of households whose income was lower than 200k, 1655.

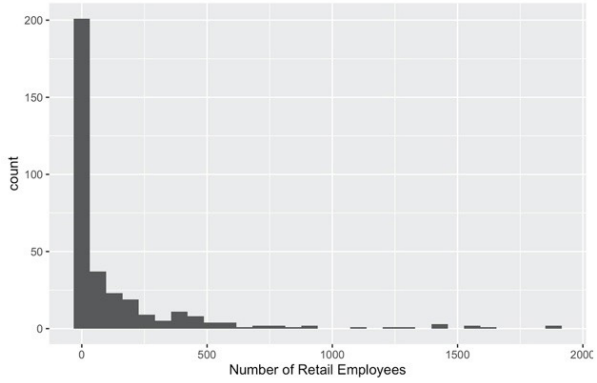



Fg7. Numer of employees

Fg8. Numer of basic employees

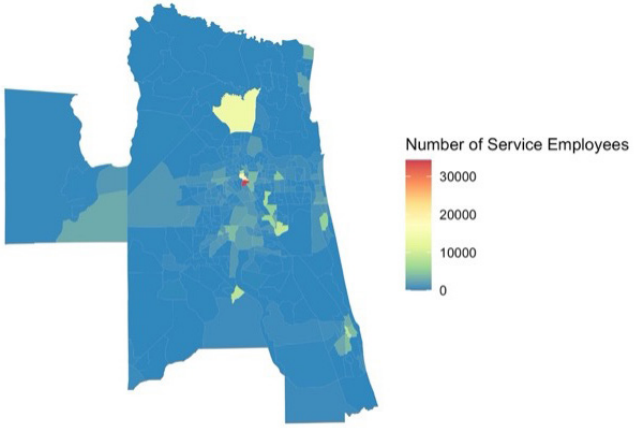
Fg9. Numer of retail employees

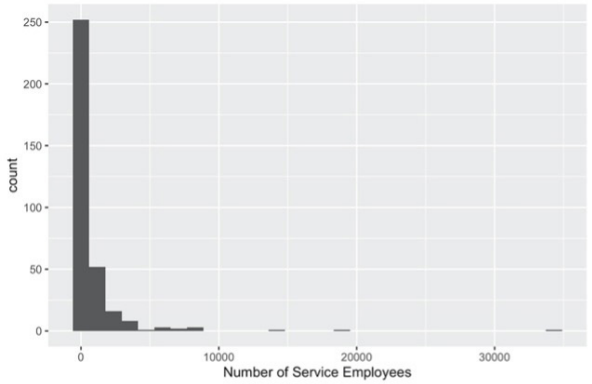
## Land Use / Employment Characteristics

There are 423,131 employees in the Jacksonville Metropolitan Area. Among the total 340 census tracts of the Jacksonville Metropolitan Area, there are only 183 of them have employees. Among all kinds of employees, 23% of the employees are basic employees. 65% of the employees are service employees. 11% of the employees are retail employees. The descriptive statistics of the number of total employees, the basic employees, the retail employees, and the service employees are shown in Table 1.

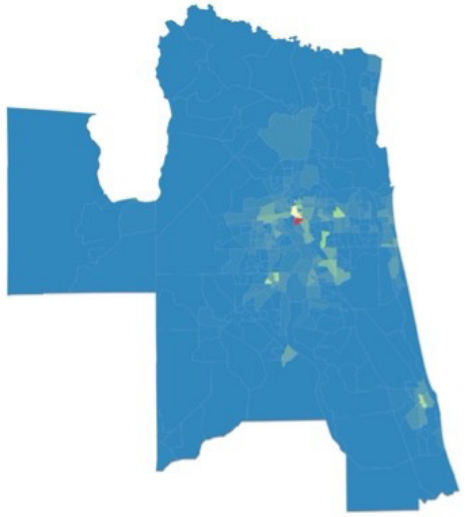
| | Total employees | Basic employees | Retail employees | Service employees |
|---|---|---|---|---|
| Mean | 2312 | 548 | 265 | 1499 |
| Median | 1095 | 156 | 125 | 586 |
| Min | 42 | 0 | 0 | 18 |
| Max | 35681 | 9041 | 1883 | 34312 |

Table 1. Statistics of the number of total employees, the basic employees, the retail employees, and the service employees at census tract level



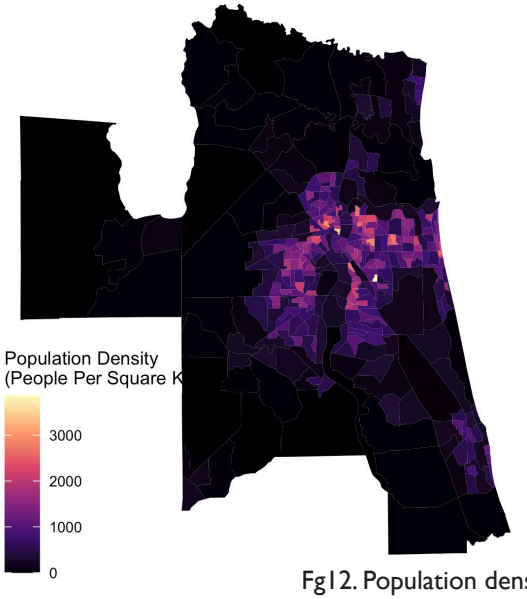

Fg10. Numer of service employees




Fg11. Employment density

**Employment Density**

There is an extremely unbalanced distribution of employment density among census tracts. The median employment density of census tract is 13.16 employees per square kilometer, while the maximum employment density is 10764.59 per square kilometer. The census tract with the highest employment density is located at the center of the metropolitan area. The distribution of the activity density, measured by the total number of population and employees per square kilometer, is also unbalanced throughout the metropolitan area. The median activity density of census tract is 915.6 people per square kilometer, while the maximum employment density is 11,631 people per square kilometer.




Fg12. Population density

## Demographics

According to the 2021 American Community Survey 1-Year Estimates, around 1.58 million people lived in JMA, which has increased by around 21.4% since 2010. The population density was about 178 per square kilometer, much lower than in a similar metropolitan area. Census Tract 159.25 in Duval County had the highest population density of 3,861 per square kilometer.

The population was very young, with a median age of 39.5 (Census Reporter, 2021). The JMA was not a racially diverse area - 60% of the population was white, followed by 20% black, 10% Hispanic, and 4% Asian. There is only a 10% foreign-born population, around half the rate in Florida. 92.2% of the population has a high school degree. 35.3% of the population has a bachelor's degree or higher, slightly higher than the 33.2% of Florida.

© Credit: Employment - related research was carried out by Joy Linyue Zhang

# A03. Road Network Skim

## Methodology

I used TransCAD to generate a travel time matrix with an estimated vehicle travel time to and from the centroid of each zone (census tracts) in JMA.

To construct the road network (Fg 13), I downloaded OpenStreetMap data for JMA from BBBike. Roadway types include: motorway, motorway_link, primary, primary_link, secondary, secondary_link, tertiary, tertiary_link, trunk, trunk_link.

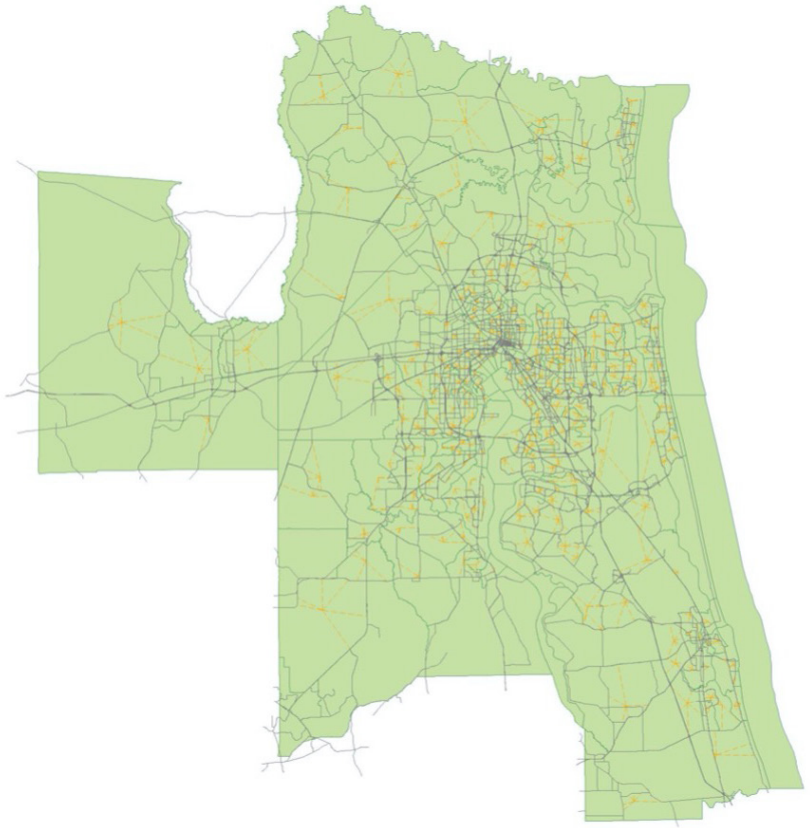
**Criteria for including links in the network**

I moved or deleted several centroids through comparison with Google Map.

Since Jacksonville has a large area of green spaces (forests, parks, etc.), I deleted the point if the tract is covered with greenery and has very few residential units (i.e., the Bayard wildlife management area). If not, I moved the point to the park's parking lot or possible endpoints that cars can reach.

Similarly, for some centroids inside the water, I check if the tract has a high population density. I either delete the centroids or move them to a point on the riverbank – I often choose a possible spot for gathering, for instance, a school or a community center, as I assume that those buildings are possibly the starting and ending points for many trips happening in the districts.
For the agricultural area, I moved the centroid from the farmland to the villages (where residential units gather).

I also modified several centroid connectors and roads. Firstly, I deleted those connectors that go across the water. Secondly, after cross-checking with Google Maps, I changed some roads from one-way to two-way. I always ensure that the road has lanes that go in different directions and that the separation line in the middle is dashed, indicating that cars can take U-turns here and go in both directions.



Fg13. Road network constructed in TransCAD

**Assumptions made about network characteristics**

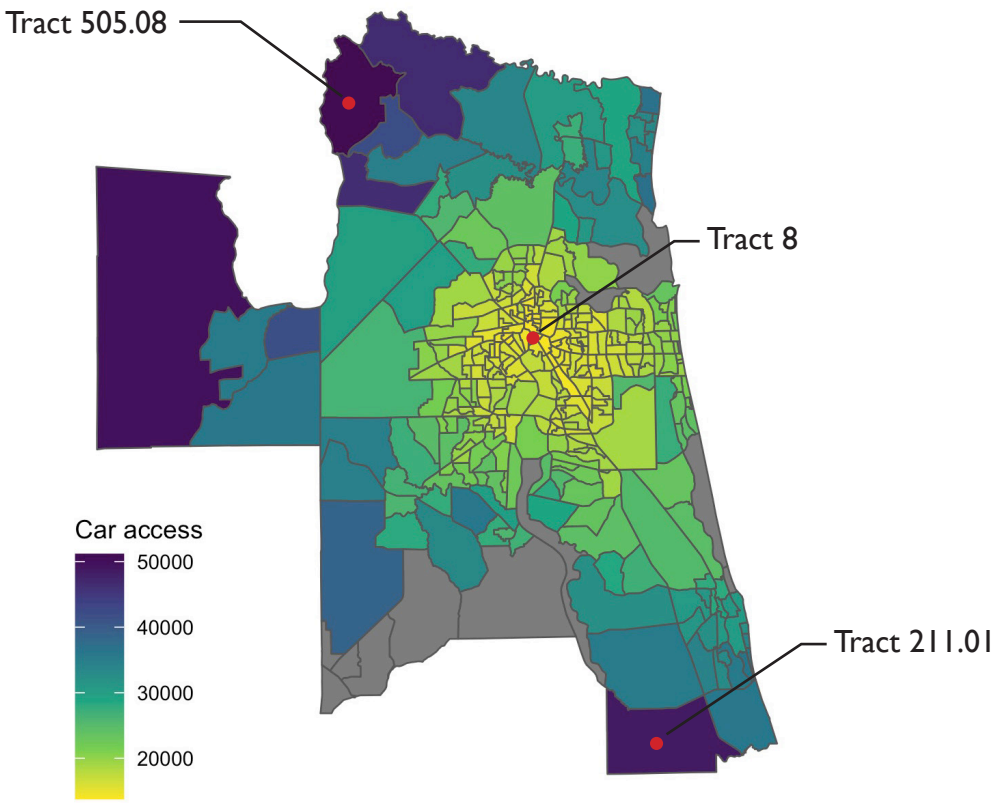
The census tracts are divided roughly according to the population size. The model assigns different travel speeds to varying types of roads, for instance, 60 mph for the primary roads. It does not take into account the diverse population densities and the congestion condition of various districts.

## Finding

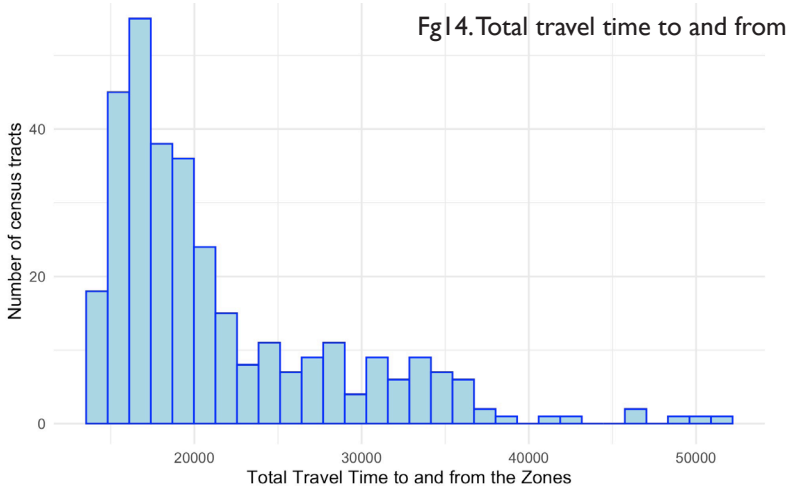
The downtown area of Jacksonville City is of the highest vehicle accessibility, while the rural district and the natural landscape area take longer time to reach. Most census tracts are quite accessible, which is presented in a right-skewed histogram (Fg 15).

Tract 211.01 (on the southern end of JMA) and Tract 505.08 (at the northwest end of JMA) are separated by the greatest travel time, around 151 minutes (2.5 hours).

Tract 8 (At the very center of JMA) has the shortest average travel times to and from the rest of the study area.




Fg14. Total travel time to and from the zones




Fg15. Histogram of total travel time to and from the zones

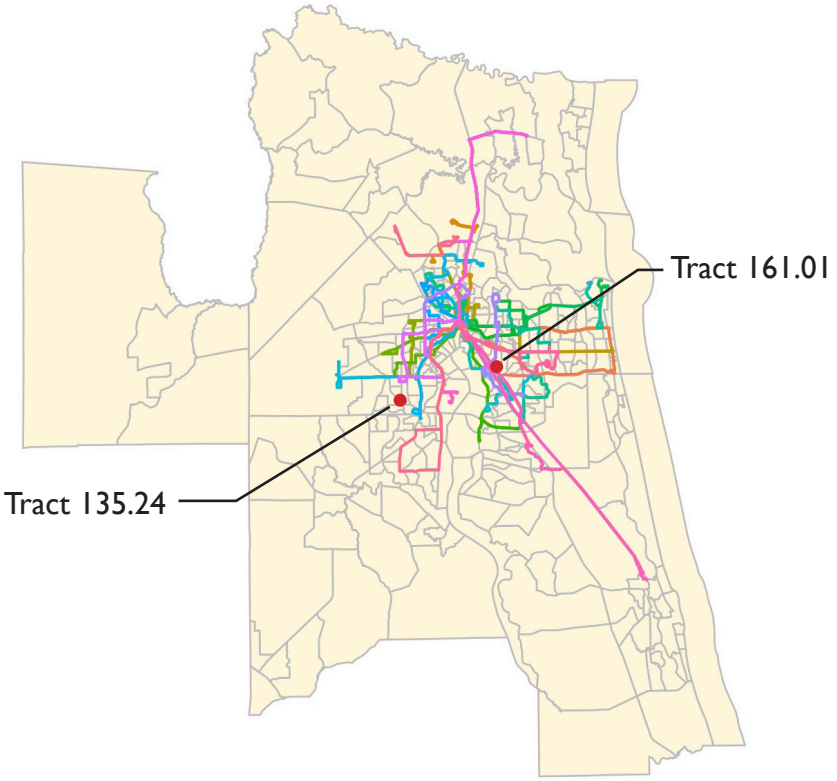
# A04. Public Transit Skim

## Methodology

I used TransCAD to generate several matrices about the fare, In-Vehicle Travel Time (IVTT), Transfer wait time, Access walk time, Egress walk time, total time, and number of transfers to travel to and from the centroid of zones (census tracts) within the serving area of public transit.

The travel model used GTFS data covering the time period of 4 pm to 7 pm, the peak commute hour after work. The headway for transit service is 20 minutes, and the maximum initial wait time is 30 minutes. I used 20 miles per hour as the average transit speed.

Jacksonville Transportation Authority offers various types of public transit, including buses, metro (Jacksonville Skyway), and Connexion service for eligible ADA and transportation disadvantaged (TD) riders (JTA 2023) (Fg 16). I use $1.75, the regular fare for bus, as the average price of public transit.




Fg16. Public transit network constructed in TransCAD

## Finding

One of the pair of census tracts that take as high as $10.5 to travel back and forth is Tract 161.01 and Tract 135.24. One of the pair of census tracts that take only $1.75 to travel from one to another is Tract 166.06 and Tract 157.02 (See Table 2).

If at least one transfer needs to be made, the shortest transfer wait time is 13 minutes. The longest transfer wait time is 196 minutes, from Tract 23 to Tract 131. This pair also takes the longest total time, around 392 minutes. 5 transfers need to be made along this trip.

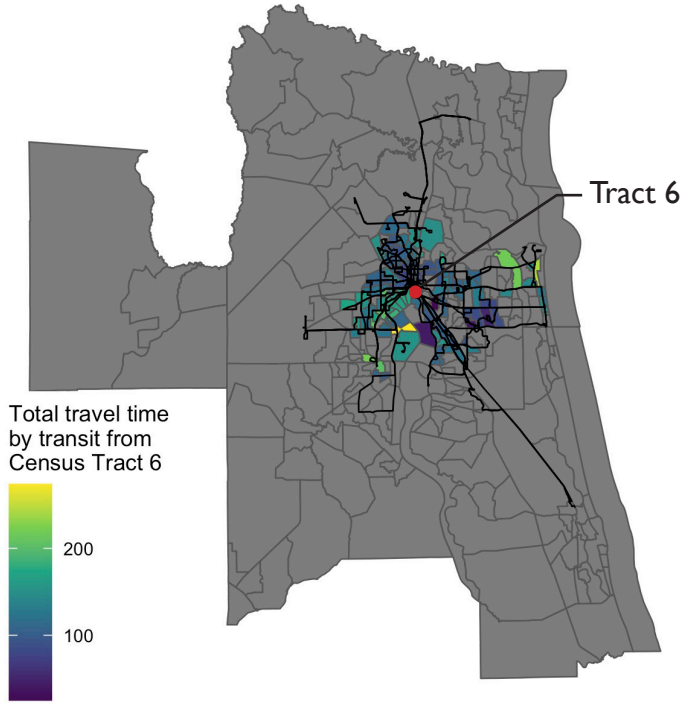
The longest in-vehicle travel time is 181.7 minutes (around 3 hours) from Tract 144.27 to Tract 143.30.

| | Fare ($) | IVTT (min) | Transfer wait time (min) | Access walk time (min) | Egress walk time (min) | Total time (min) | Number of transfers |
|---|---|---|---|---|---|---|---|
| Mean | 6.11 | 61.19 | 54.66 | 0.75 | 0.76 | 149.00 | 2.49 |
| Median | 7.00 | 58.81 | 57.50 | 0.74 | 0.79 | 145.86 | 3 |
| Minimum | 1.75 | 0.61 | 0 | 0.02 | 0.02 | 1.92 | 0 |
| Maximum | 10.50 | 181.70 | 196.00 | 1.92 | 1.49 | 392.26 | 5 |

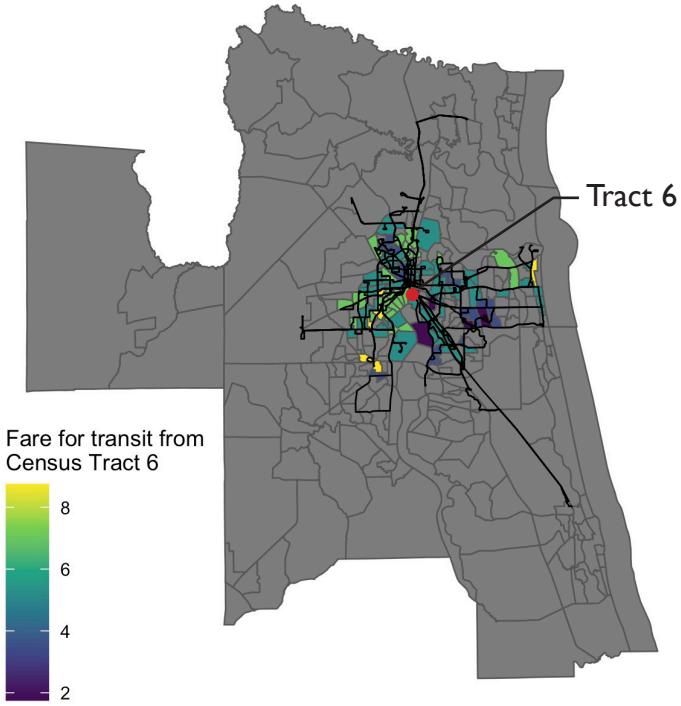
Table 2. Statistics of fare, In-vehicle travel time (IVTT), Transfer wait time, Access walk time, Egress walk time, Total time, Number of transfers

According to 2021 ACS 5-year data, Tract 6 in Duval County had the greatest number of households whose income was lower than 10k. I imagine that compared with middle-to-high-income families, a higher proportion of low-income families had less access to cars and used more public transit. Therefore, it is essential to understand whether the current transit system can bring low-income households to reach different places in the metropolitan area.

For Tract 6, it at most takes $8.75 to reach Tract 135.24, Tract 139.06, etc. (Fg 18). On average, it takes $5.3 to travel around. Taking public transit to Tract 131 takes the most time, 274 minutes (around 4.5 hours) (Fg 17).




Fg17. Total travel time by transit from Census Tract 6




Fg18. Total fare for transit from Census Tract 6

# A05. Accessibility

## Methodology

This analysis looks into the car accessibility and the transit accessibility of Jacksonville Metropolitan Area (JMA).

For car access, I used the car travel time matrix generated from A03.

For the public transit, I used the matrices generated from A04. Moreover, since people are in general more bothered by the out-of-vehicle travel time (OVTT) than in-vehicle travel time (IVTT), this model weight OVTT to be 2 times as bad as IVTT to generate a "perceived travel time". The calculation is

percieved_time = IVTT + 2 * OVTT

It focuses on access to jobs – the employment data of each census tracts comes from the Longitudinal Employer-Household Dynamica (LEHD). I define a logistic accessibility decay function to calculate a weight for the jobs in each tract. Then, I aggregate by the trip origins and by assigning a value of 100 to the maximum access, I calculate an index to show relative accessibility.

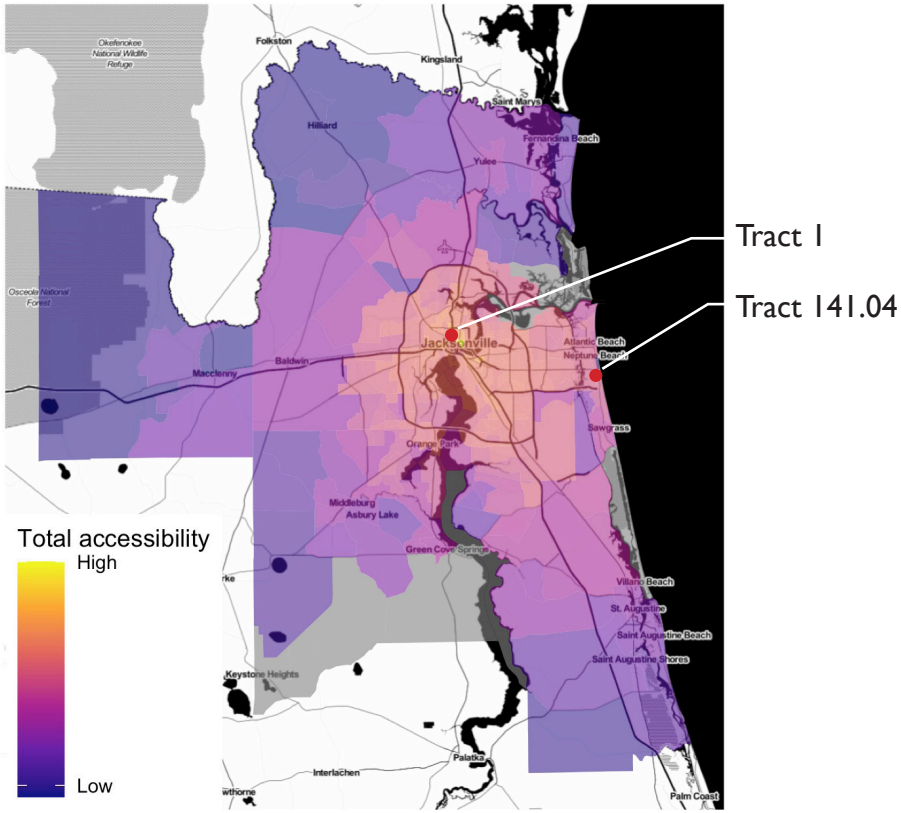
Since JMA is a car-dependent region, I view car access as 2 times more important as transit access. I generate a total accessibility index through a calculation of

total_access_index=(2*car_index+ transit_index)/3

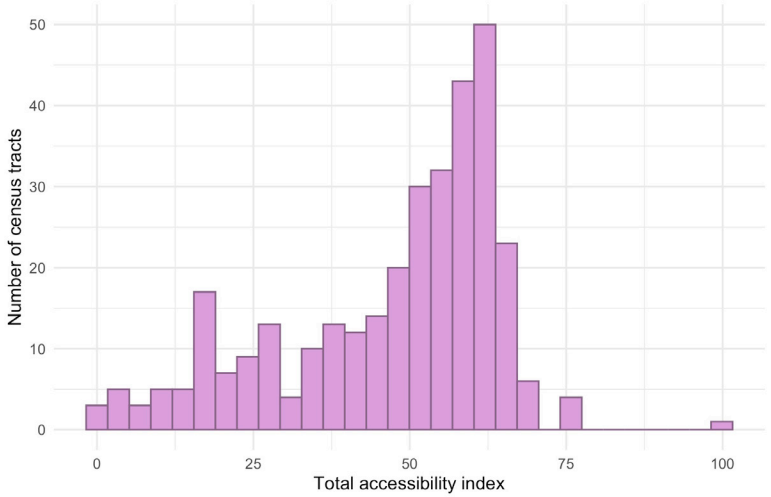
## Finding

### Total Accessibility

The downtown area of Jacksonville city is of the highest total accessibility (Fg 19 & Fg 20). The average total accessibility index of census tracts is 47.01 and the median is 52.73. Tract 141.04 has the lowest total accessibility index of 0.13, while Tract 1 has the highest total accessibility index of 100.



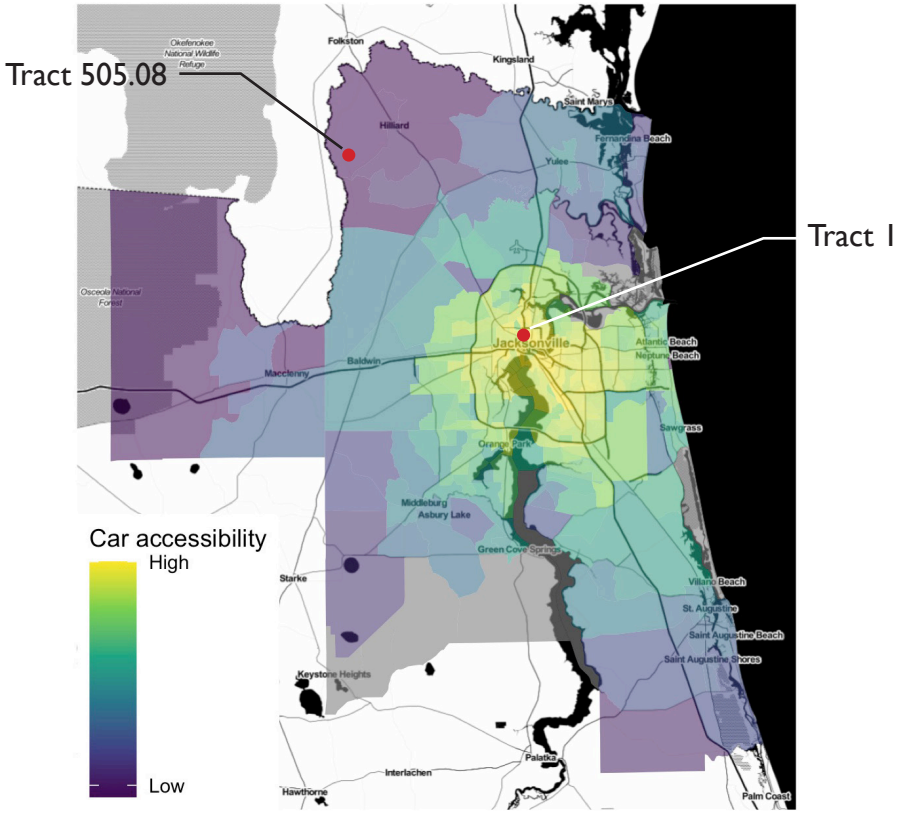

Fg19. Map of total accessibility index



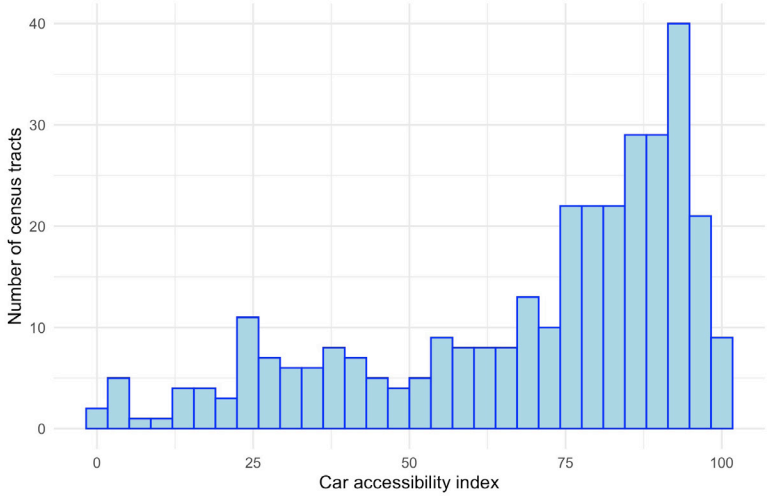

Fg20. Histogram of total accessibility index

### Car Accessibility

Most districts are of very accessible by car (Fg 21 & Fg 22). This result is in accordance with the fact that JMA is a car-dependent region. Compared with the rural districts and landscape at the periphery, the central part is more accessible. The average car accessibility index of census tracts is 69.71 and the median is 79.07. Tract 505.08 has the lowest total accessibility index of 0.71, while Tract 1 has the highest total accessibility index of 100.




Fg21. Map of car accessibility index




Fg22. Histogram of car accessibility index

**Transit Accessibility**

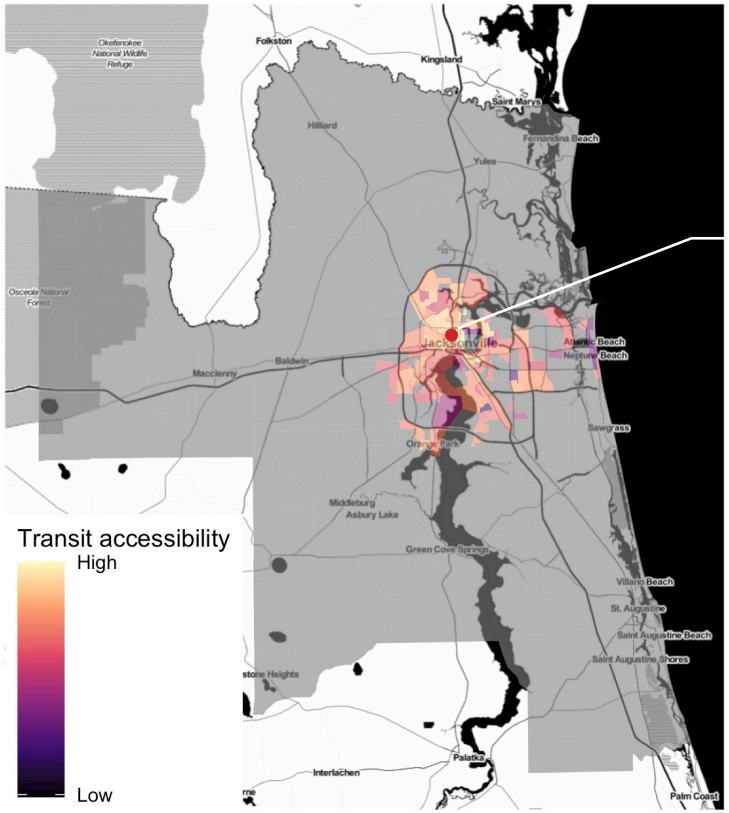
Very few census tracts in the center of JMA are served by public transit (Fg 23 & Fg 24). The average transit accessibility index of census tracts is 1.61 and the median is 0. Many tracts are not within the service area of public transit. Tract 1 has the highest transit accessibility index of 100.

In all, the central urban area of JMA is most accessible both by car and by transit. Meanwhile, the peripheral zones take longer to drive to, and are not reached by public transit. While the surrounding area are mostly rural districts, forests, and parks, the lack of transit may cause low-income groups in central area less access to nature, and those in suburban area less access to job opportunities in town.

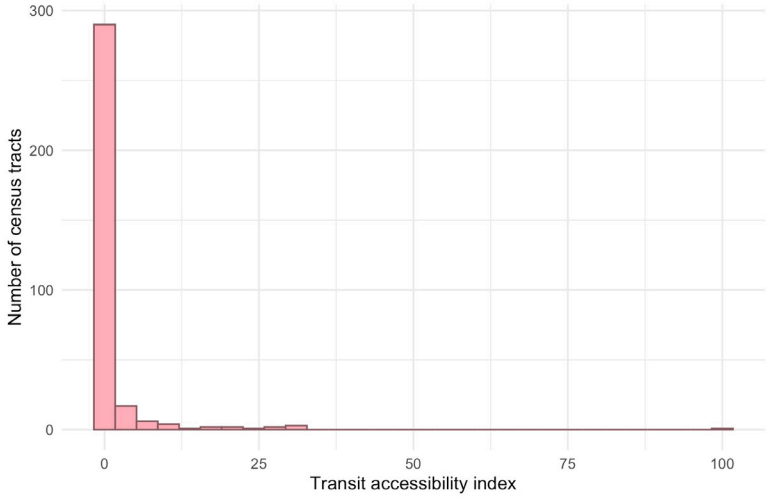
Peer Review Partner: Inkoo

Feedback:

Mengyao—
First of all, I found it interesting to compare our work, particularly because you focused on the Jacksonville 'Metropolitan' Area while I only examined the city of Jacksonville. Your work has been very organized so far, with a clear narrative and thorough explanations of assumptions and findings. I also appreciate how well you integrated images, graphs, and text. What stood out to me in your accessibility analysis this week were the effective use of color coding to represent car accessibility (in blue), transit accessibility (in red), and total accessibility (in purple - the mixture of blue and red), and also the summary of your findings at the end.
— Inkoo




Fg23. Map of transit accessibility index




Fg24. Histogram of transit accessibility index

# Data Sources & References

American Community Survey 5-Year Data (2009-2021)

LEHD Origin-Destination Employment Statistics

Source of road network data:
- OpenStreetMap road data from bbbike (https://extract.bbbike.org/)
- Boundary of census tracts from Tiger/Line Shapefiles (https://www.census.gov/cgi-bin/geo/shapefiles/index.php )
- Centroids and centroid connectors generated with TransCAD
- Comparison with Google Map

Source of public transit network data:
- Jacksonville GTFS data
- Jacksonville Transportation Authority. 2023. "JTA Fares." https://www.jtafla.com/ride-jta/fares-passes/