



Multimodal transportation services for tourism in Tennessee

**TNMUG Meeting
19th May 2022**

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Presentation Overview

- Introduction
- Analysis of tourism trip characteristics
- Identification of popular tourist attractions
- Access to popular tourist attractions
- INRIX Trip Analytics for trip data analysis
- Conclusion

Introduction

Need for sustainable transportation system in Tennessee

Importance

- Tourism is one of the largest industries in Tennessee
- Tourism generates substantial employment and tax revenue
- The industry has grown considerably in recent years

Tourism in Tennessee Based on 2018 report by the Tennessee Department of Tourist Development (TDTD)	Travel Expenditures <i>\$22.02 Billion</i>	Payroll <i>\$4.99 Billion</i>
	Tax Revenue <i>\$1.81 Billion</i>	Employment <i>189,757</i>
	International Traveler Expenditure growth <i>5.4% (7x the national average)</i>	

Problem

- Major Tennessee cities popular for tourism are ranked among the most congested in the US
- A well-planned multimodal transportation system is essential to serve TN's fast growing tourism industry
- A better understanding of tourism trips made to the state is necessary

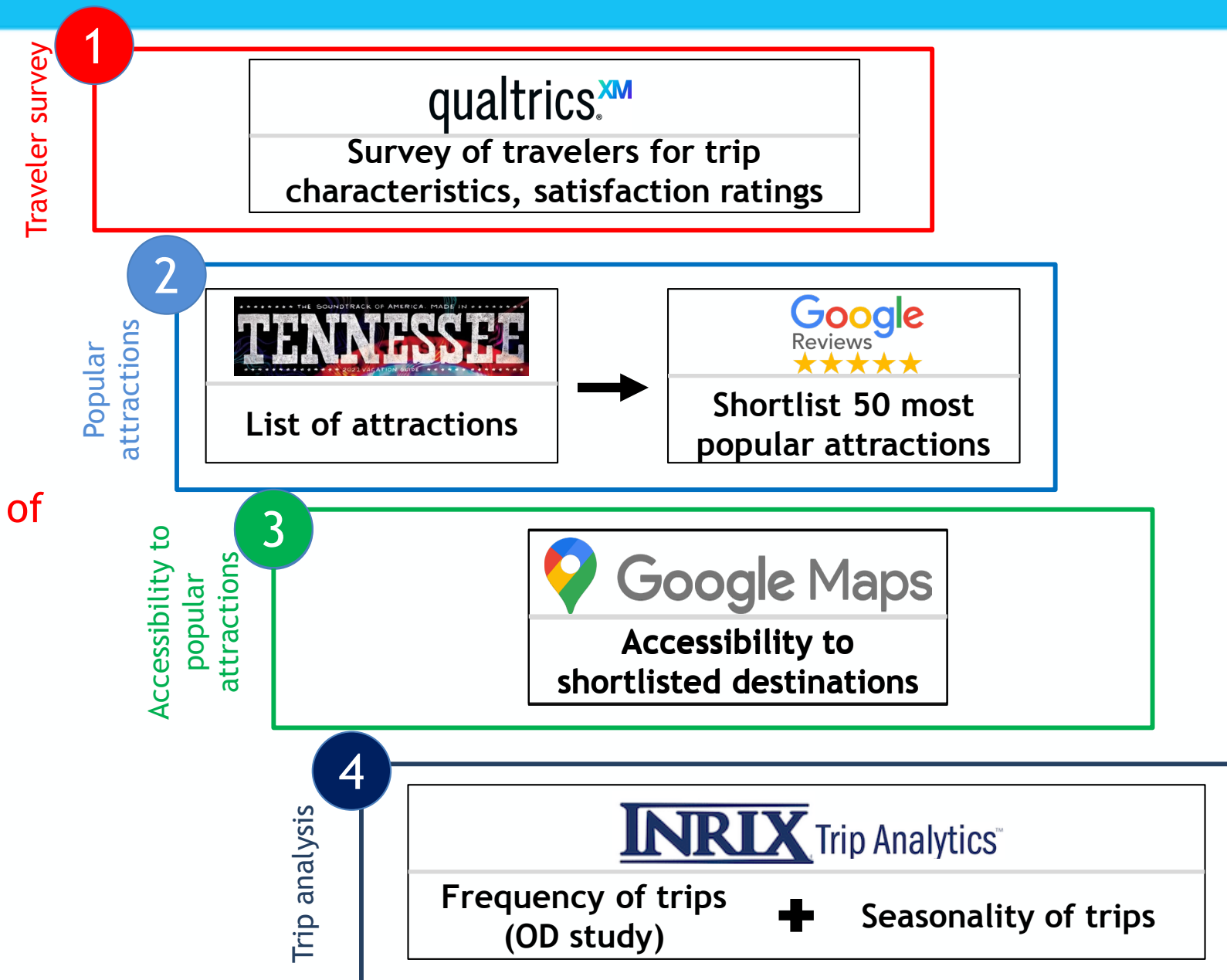
Introduction

Objectives

- Gather a better understanding of tourism travel
 - Trip characteristics
 - Identification of popular tourist attractions in the state
 - Proportion of long-distance trips to attractions

Approach

1. Analysis of tourism trip characteristics obtained from online survey of travelers collected using Qualtrics
2. Identification of popular destinations done in two steps
 - List of attractions obtained from 2022 Tennessee Vacation Guide
 - 50 most popular attractions chosen from the list based on Google reviews
3. Accessibility to popular attractions determined using Google Maps
4. Trip analysis done using data obtained from INRIX Trip Analytics



Analysis of tourism trip characteristics: Introduction

Objectives

- Trip characteristics are integral to long-distance travel demand analysis
- Analysis of trip characteristics was done to:
 - Better understanding socio-demographic attributes of travelers
 - Preference of using multimodal transportation services

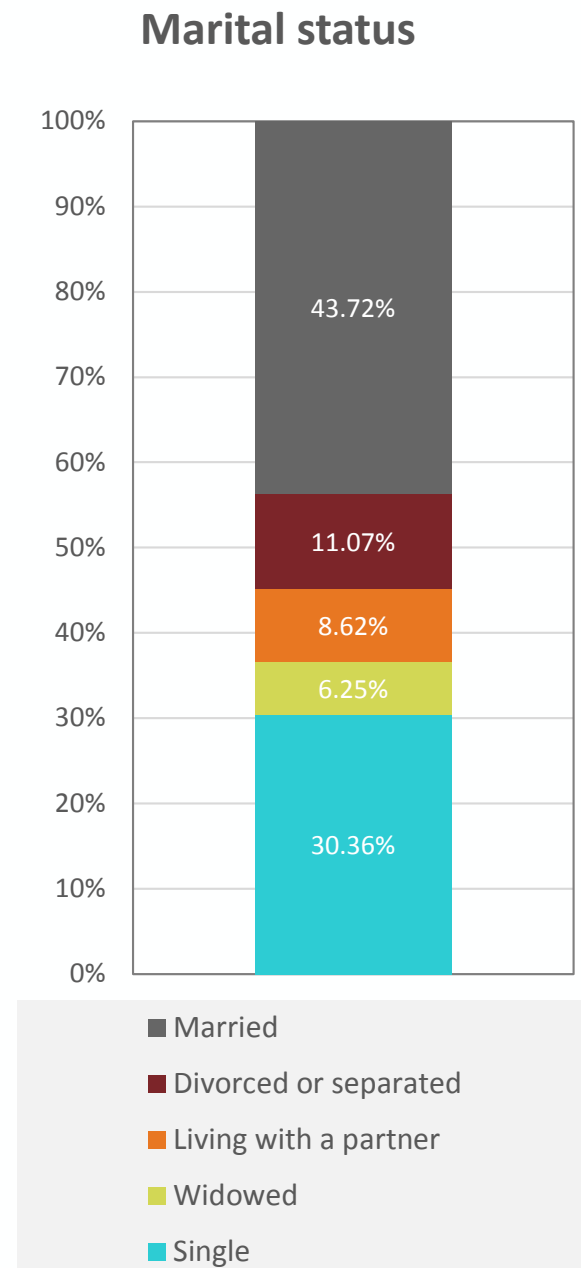
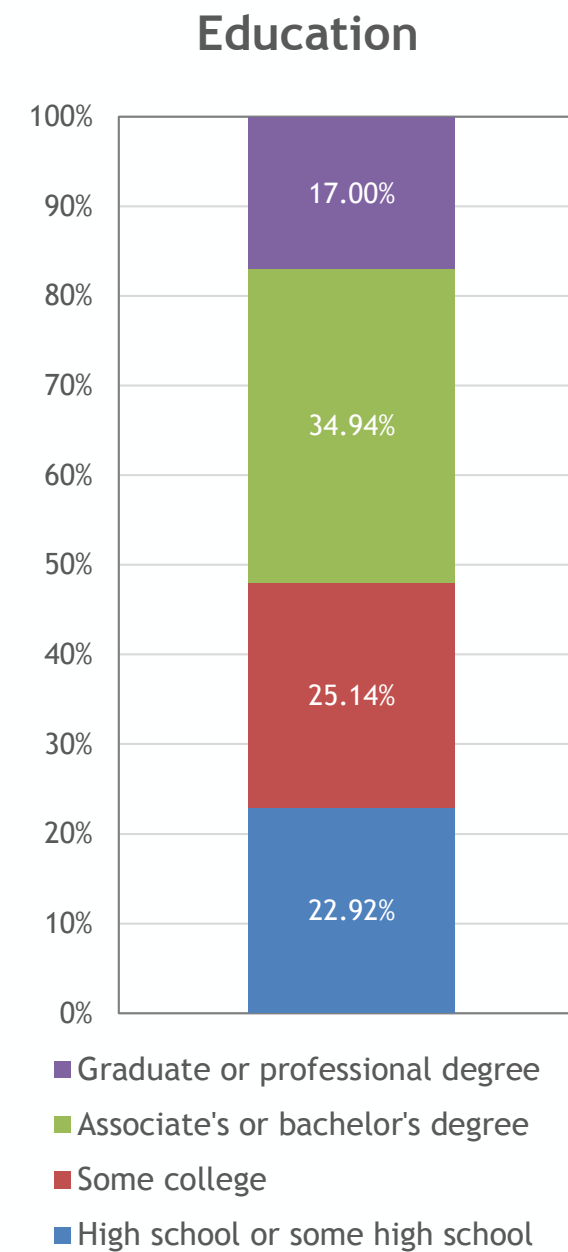
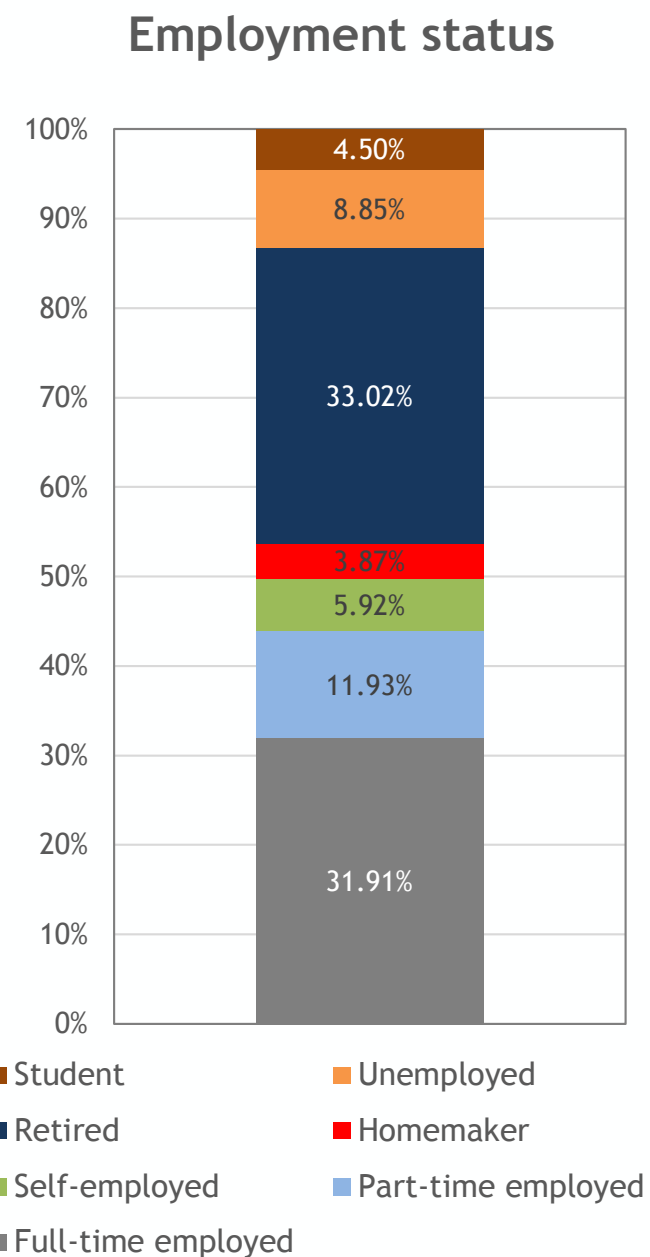
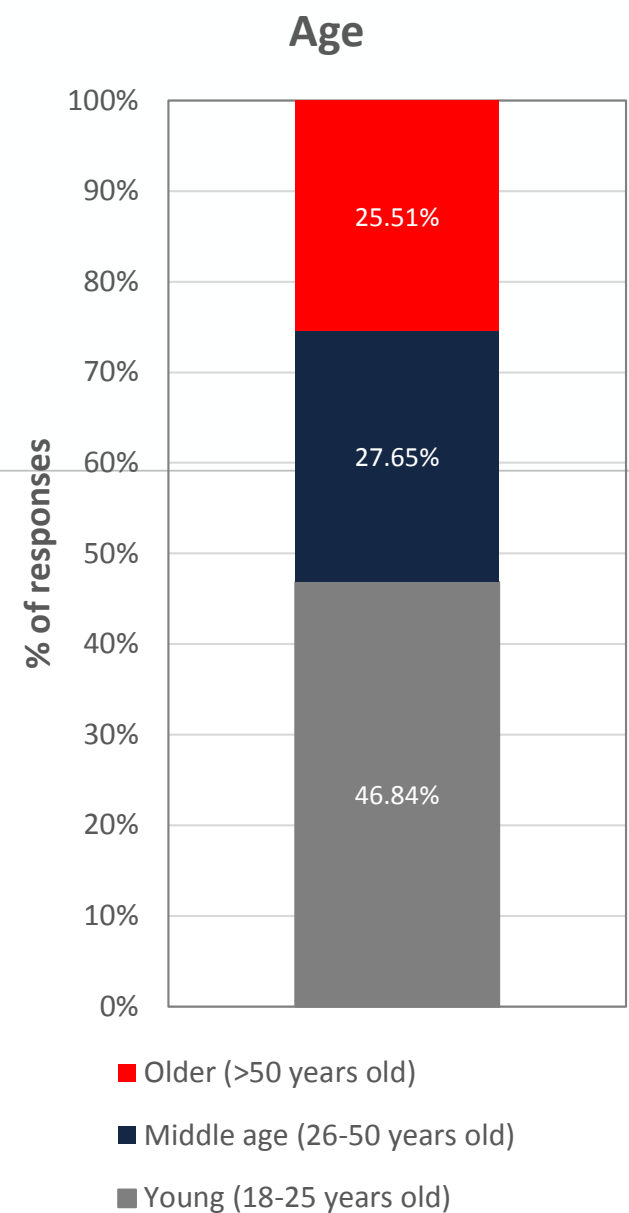
Approach

- A survey was administered to among TN tourism travelers
- The survey asked questions on
 - Personal attributes: Age, gender, personal income, etc.
 - Household attributes: Household size, number of vehicles, residential location type, etc.
 - Trip characteristics for their recent visit to Tennessee: Mode of travel, duration of stay, time of visit, etc.
 - Satisfaction ratings: Feeling of safety, experience in sight seeing, etc.

Tourism Traveler Survey	Survey details
	<i>Undertaken between June– July, 2021</i>
	<i>Participants were 18 and above and past visitors of Tennessee</i>
	<i>Followed a quota sampling approach based on gender and age</i>
	<i>Collected 1,259 complete responses</i>

Analysis of tourism trip characteristics: Results

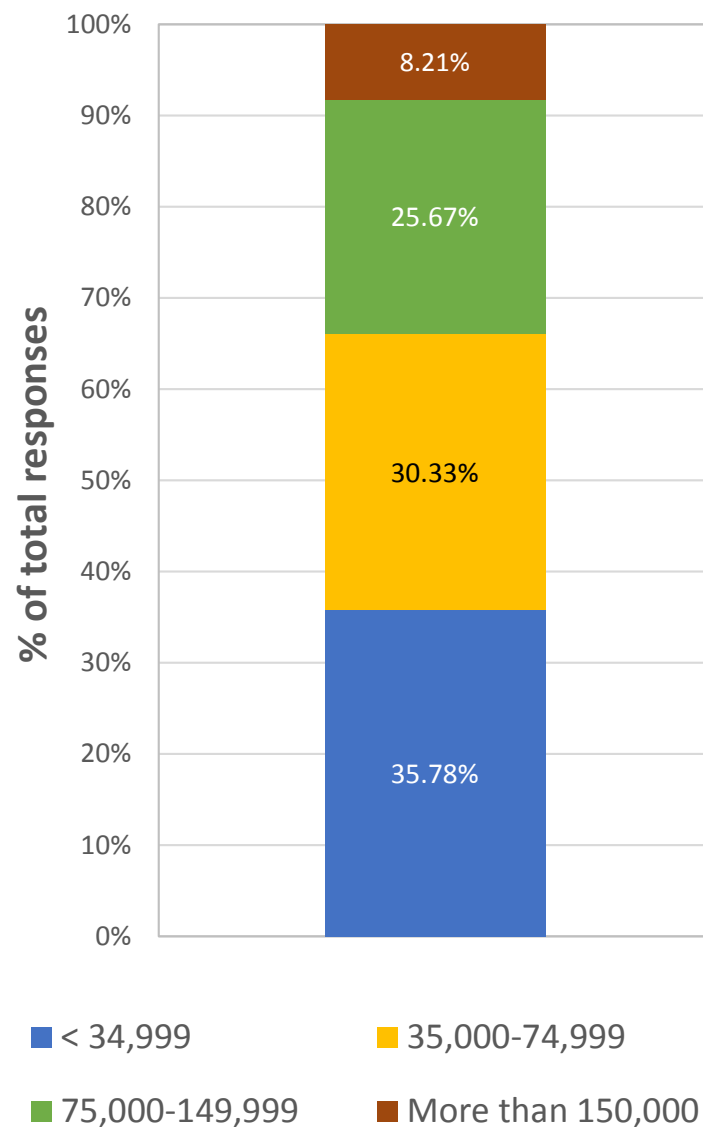
Personal attributes of travelers



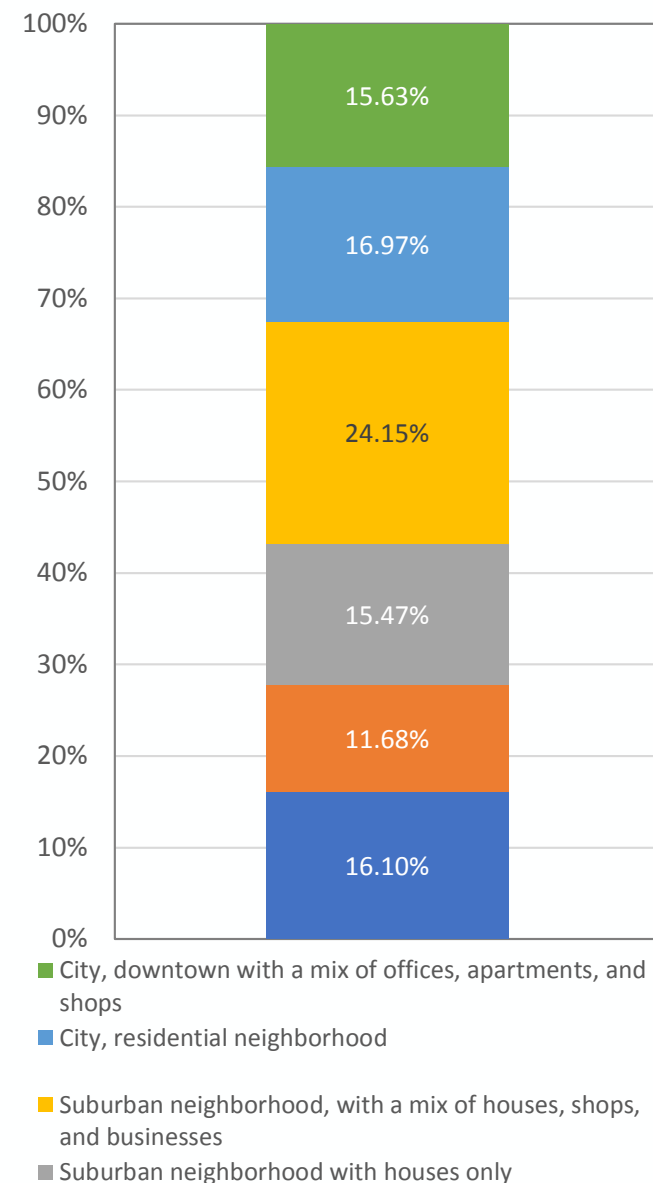
Analysis of tourism trip characteristics : Results

Household attributes of travelers

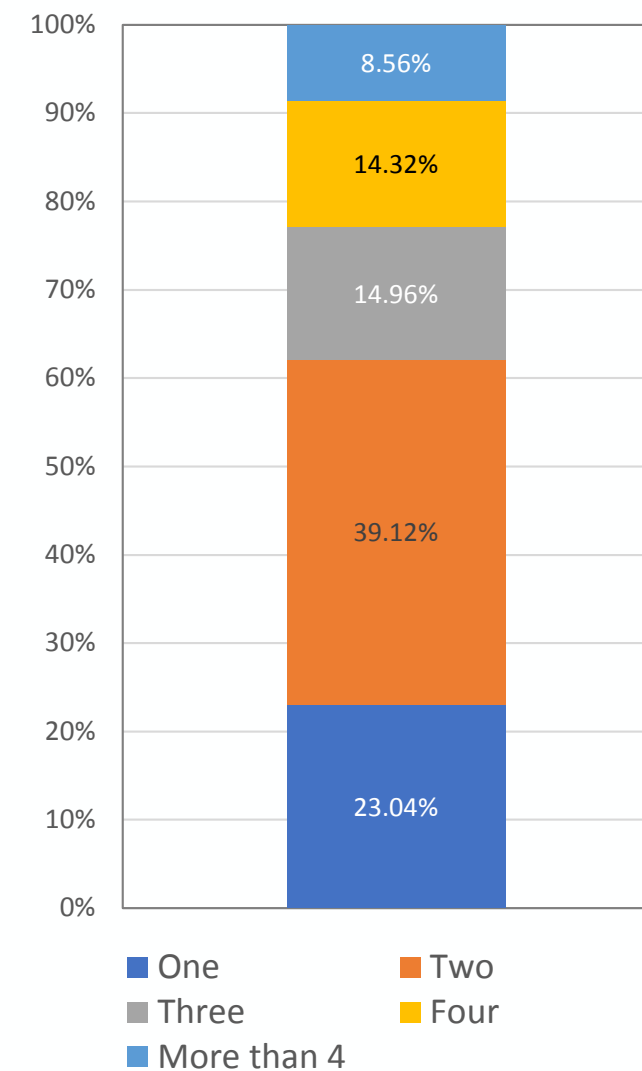
Household income of travelers (USD)



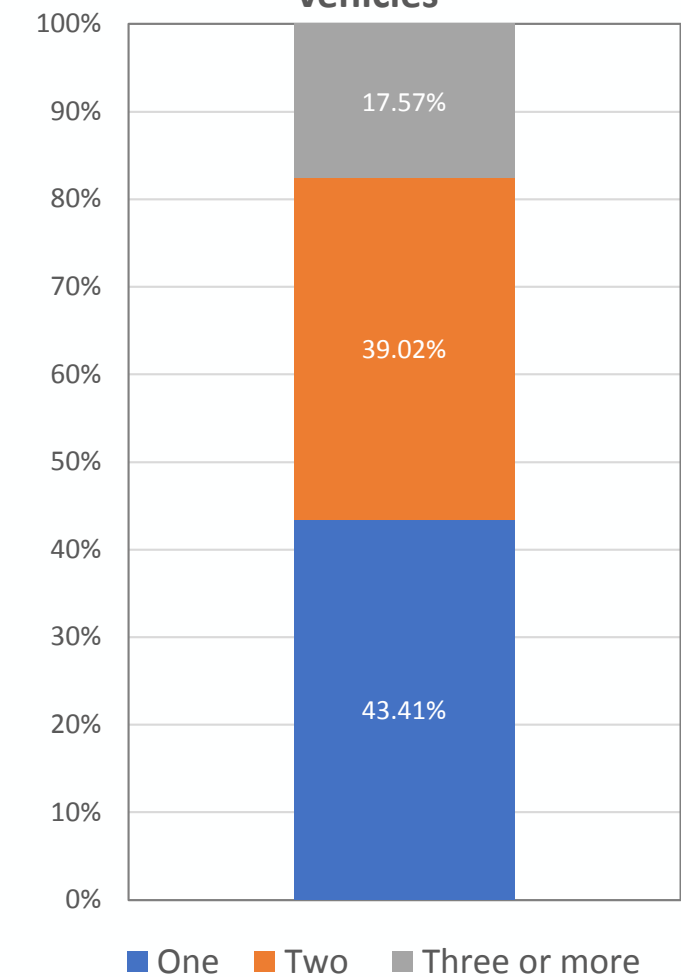
Residential location type



Number of household members



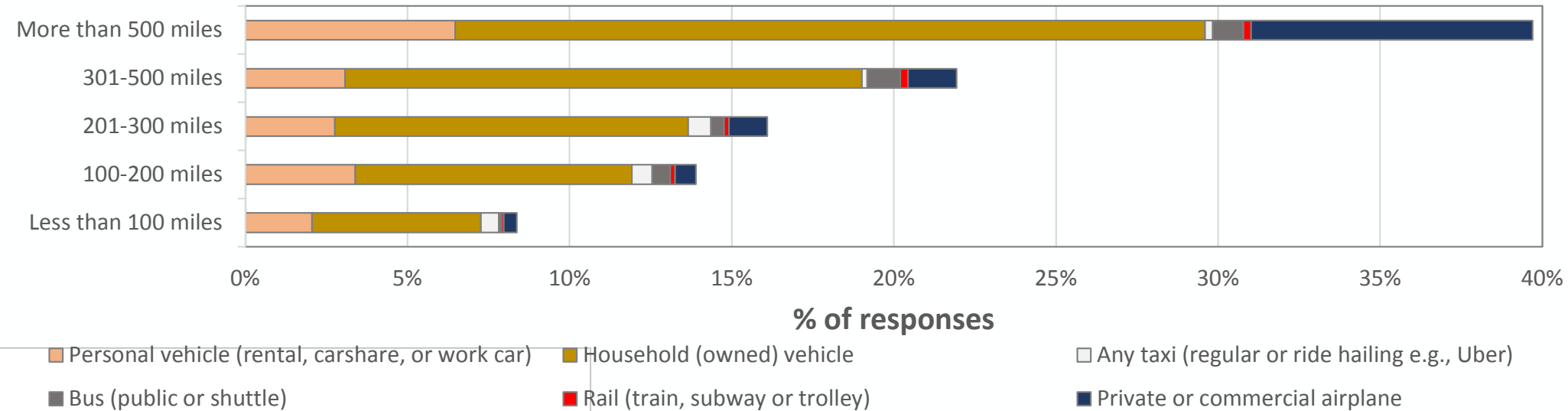
Number of household vehicles



Analysis of tourism trip characteristics: Results

Travel mode and trip timing

Travel mode by distance

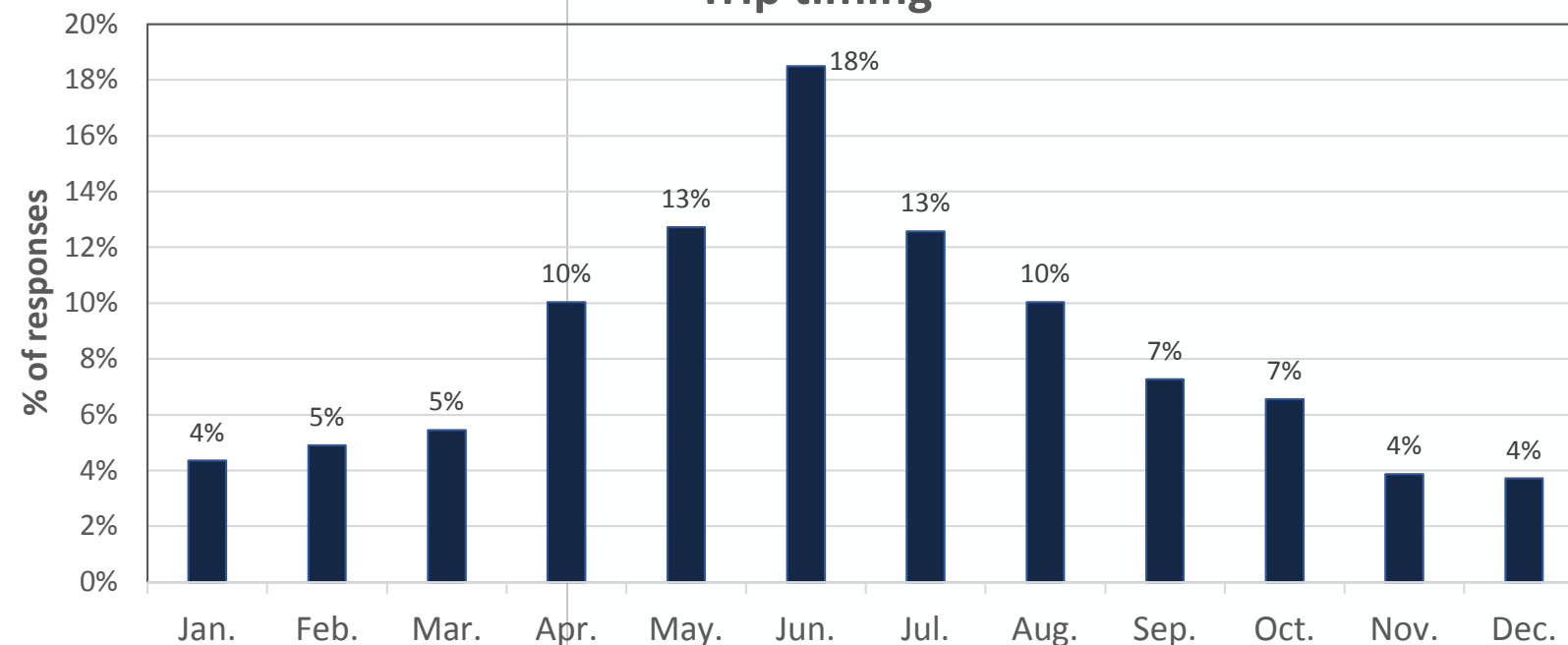


Mode of travel

Household vehicle is the most popular mode

There is notable increase in the use of airplanes beyond 500 miles

Trip timing



Trip timing

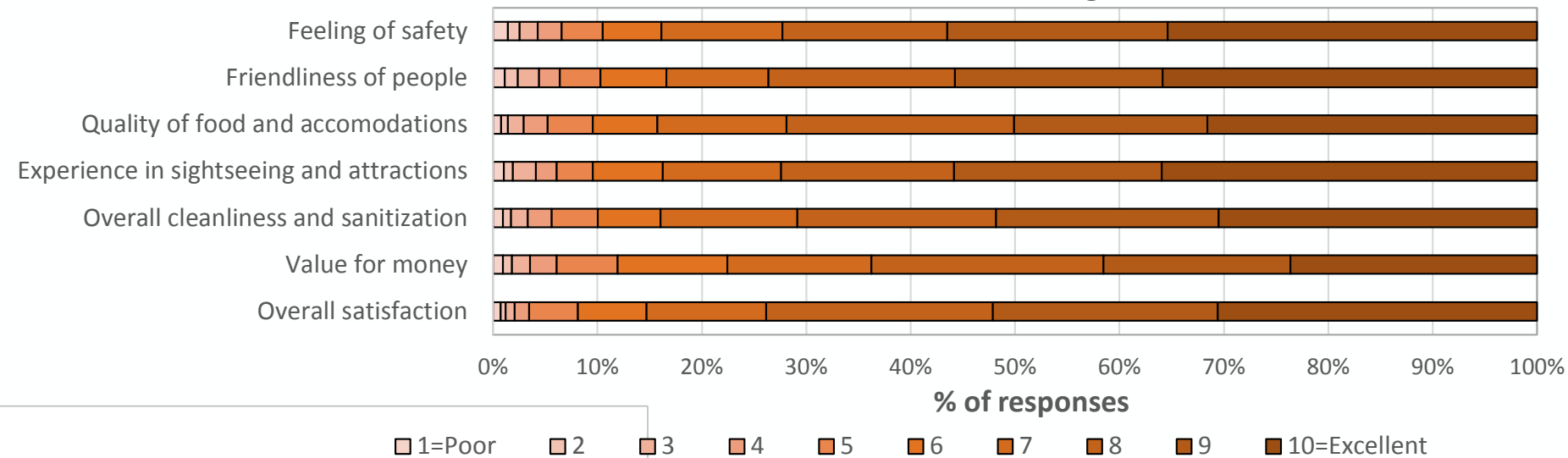
About 1 in 5 trips are made in June

Spring and Summer together experience more than two-thirds (68%) of travel.

Analysis of tourism trip characteristics: Results

How satisfied are tourists with the tourism services in the state? How long do they stay?

Satisfaction ratings from travelers



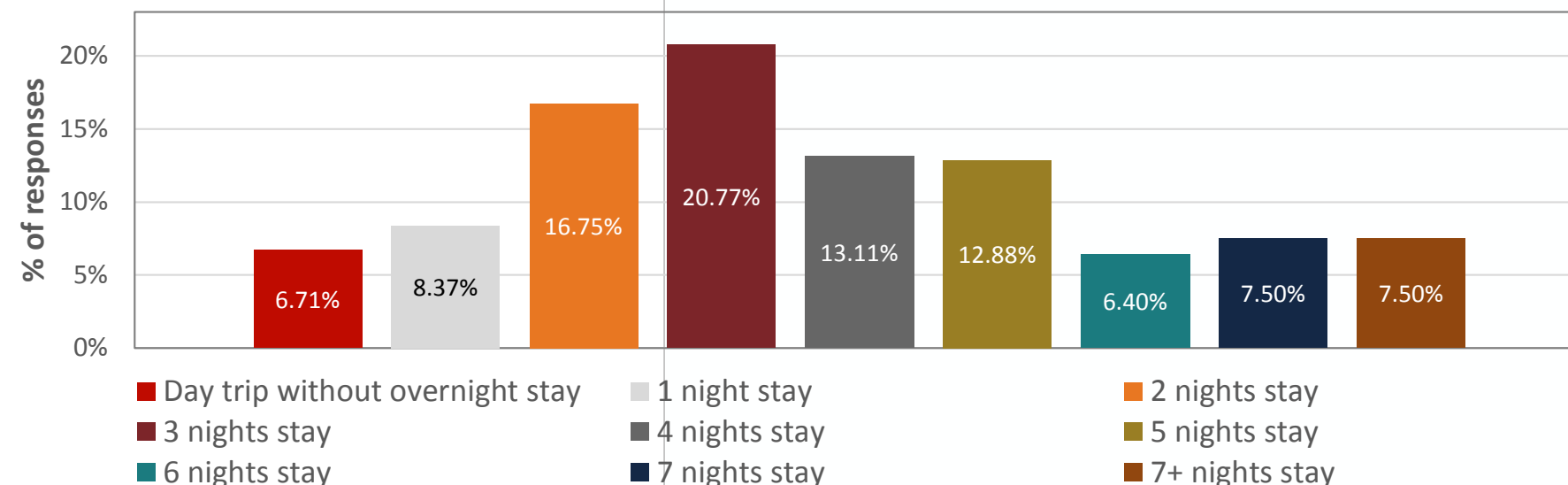
Satisfaction ratings

Tourists are least satisfied with “value for money”

Most satisfaction is observed in

- Feeling of safety
- Friendliness of people
- Experience in sightseeing and attractions

Duration of stay



Duration of stay

Almost half of all travelers prefer staying 2-4 nights

Only about 6% travelers make day trips without staying overnight.

Identification of popular attractions: Introduction

What are the most popular destinations in Tennessee

Objectives

- Identify most popular destinations in the state based on their online reviews

Approach

- Compile a list of attractions throughout the state from the Tennessee Vacation Guide
- Select 50 most popular locations based on Google Reviews
 - Attractions with at least 500 reviews
 - Attractions with at least a 4.5 star rating

Examples of attractions in East Tennessee



High Point ZIP Adventure at Ruby Falls
Get your adrenaline pumping at Ruby Falls High Point ZIP Adventure on Lookout Mountain! Take in breathtaking views as you soar through the treetops on rushing zip lines and conquer the 40-foot climbing tower. Adventure Awaits at Ruby Falls! 1720 S. Scenic Hwy., Chattanooga, 423-821-2544, rubyfallszip.com



Hunter Museum of American Art
Explore exceptional art and stunning views at the Hunter Museum. Featuring rotating exhibitions and a nationally acclaimed art collection spanning three connected buildings in downtown Chattanooga. Youth 17 and under free. Book tickets and check current and upcoming exhibitions online. 10 Bluff View, Chattanooga, 423-267-0968, huntermuseum.org



Tennessee Aquarium IMAX 3D Theater
Travel to new places and dive into new worlds at Chattanooga's premier theater with IMAX with Laser. Get immersed in the action with larger-than-life 3D images on the giant six-story screen. 201 Chestnut St., Chattanooga, 800-262-0695, tnaqua.org



Tennessee Valley Railroad Museum
The Tennessee Valley Railroad is a moving museum, offering an interactive, historical experience that will add an extra dimension to your visit to Chattanooga. Here you'll find the only regularly scheduled, full-sized train ride in Tennessee. 4119 Cromwell Rd., Chattanooga, 423-894-8028, tvrail.com

CLEVELAND

Museum Center at Five Points

The Copper Express

Climb aboard The Copper Express trackless train in the historic Copper Basin District, on the TN/GA line. Sit back, relax and cruise the quaint sister cities of Copperhill and McCaysville, GA, learn about the mining history and enjoy the scenery. 100 Ocoee St., Copperhill, 423-241-9801, facebook.com/the-copper-express-112719160465666

DUNLAP



Flying Camp Paragliding

Paraglide Tennessee! Offering flights and courses all year. Fly the skies of Tennessee with professional pilots. Minutes from downtown Chattanooga. Incredible views and amazing experiences gliding through the sky. Call for your reservation today. 1692 Window Rock Rd., Dunlap, 423-800-2228, flying.camp

ETOWAH

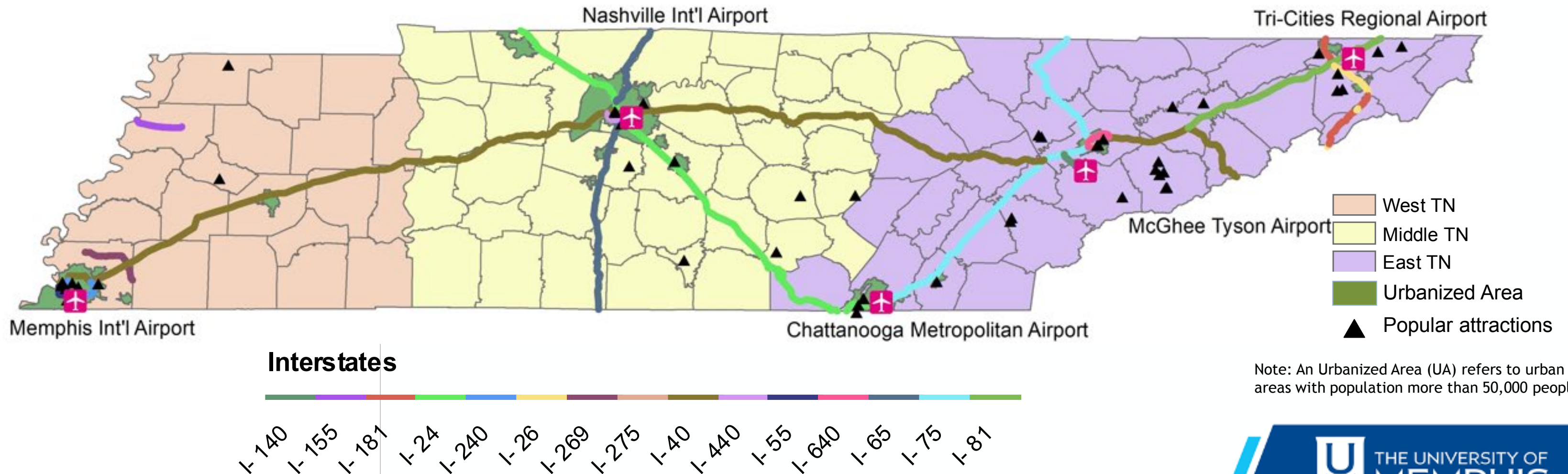
L&N Depot & Railroad Museum

Step back in time when you visit this restored, 18-room Victorian railroad station museum and active rail yard. Hiwassee River Rail Adventure

Identification of popular attractions: Results

What are the most popular destinations in Tennessee

- An initial list of over 300 attractions were compiled
- 50 of the most popular attractions identified are highlighted here



Note: An Urbanized Area (UA) refers to urban areas with population more than 50,000 people.

Access to popular destinations: Introduction

How accessible are these attractions to tourists?

Objectives

- Find accessibility to popular attractions from nearest:
 - Exits on primary interstates
 - Primary commercial airport (Commercial airports with <10,000 boardings per year)

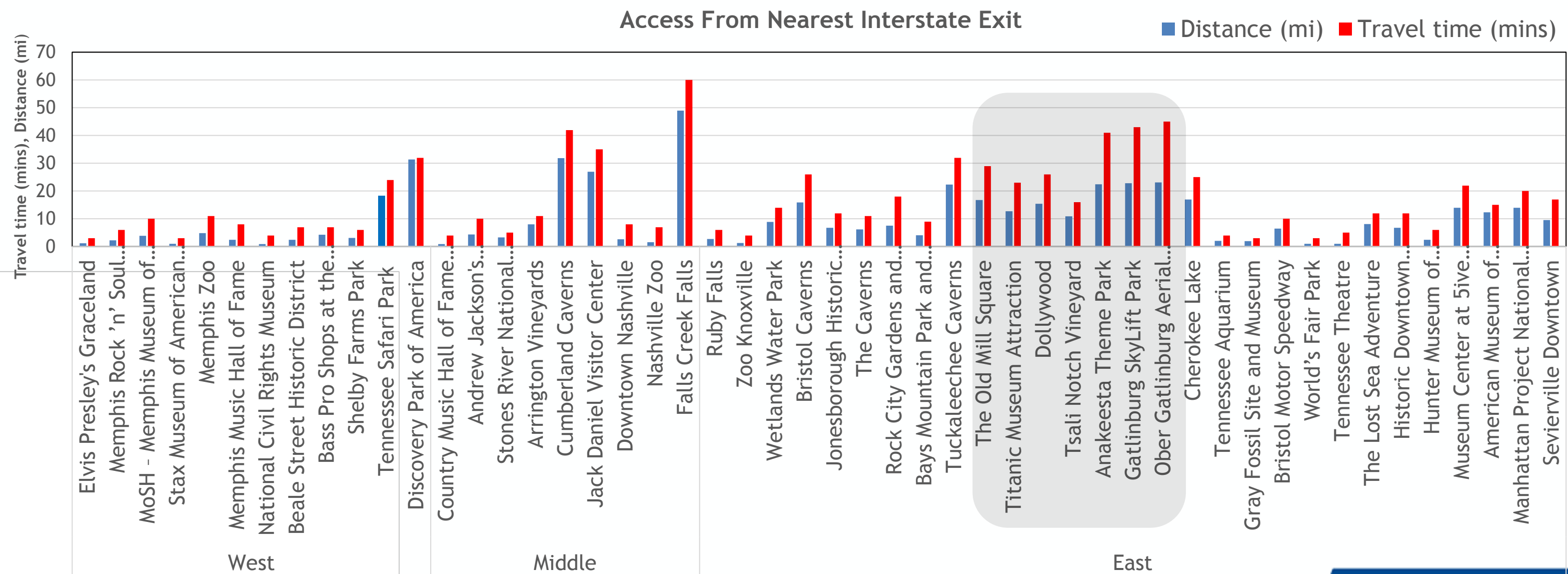
Approach

1. Compile a list of attractions throughout the state from the Tennessee Vacation Guide (from previous task)
2. Get distance and average travel times for peak hours from the nearest
 - Exits on primary interstates
 - Primary commercial airport



Access to popular destinations: Results

How accessible are these attractions to tourists?



Access from nearest Interstate Exit:

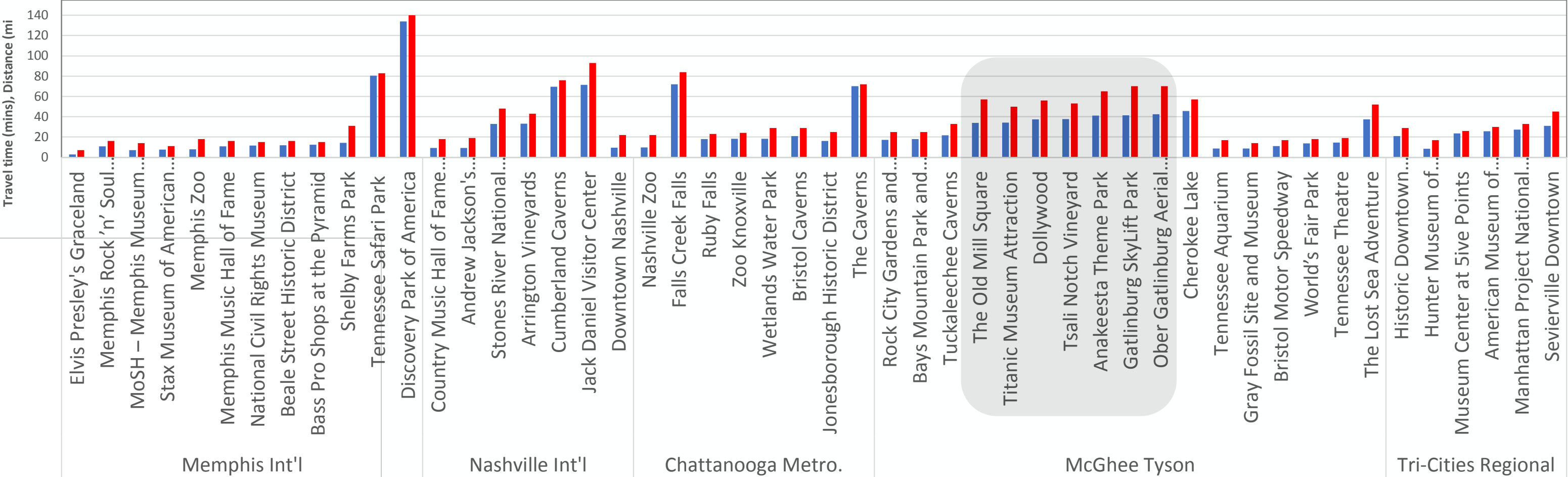
Attractions in Gatlinburg and neighboring Pigeon Forge have disproportionately larger travel times from nearest interstate exit

Access to popular destinations: Results

How accessible are these attractions to tourists?

Access From Nearest Commercial Service Airport

■ Distance (mi) ■ Travel time (mins)



Access from nearest Airport:

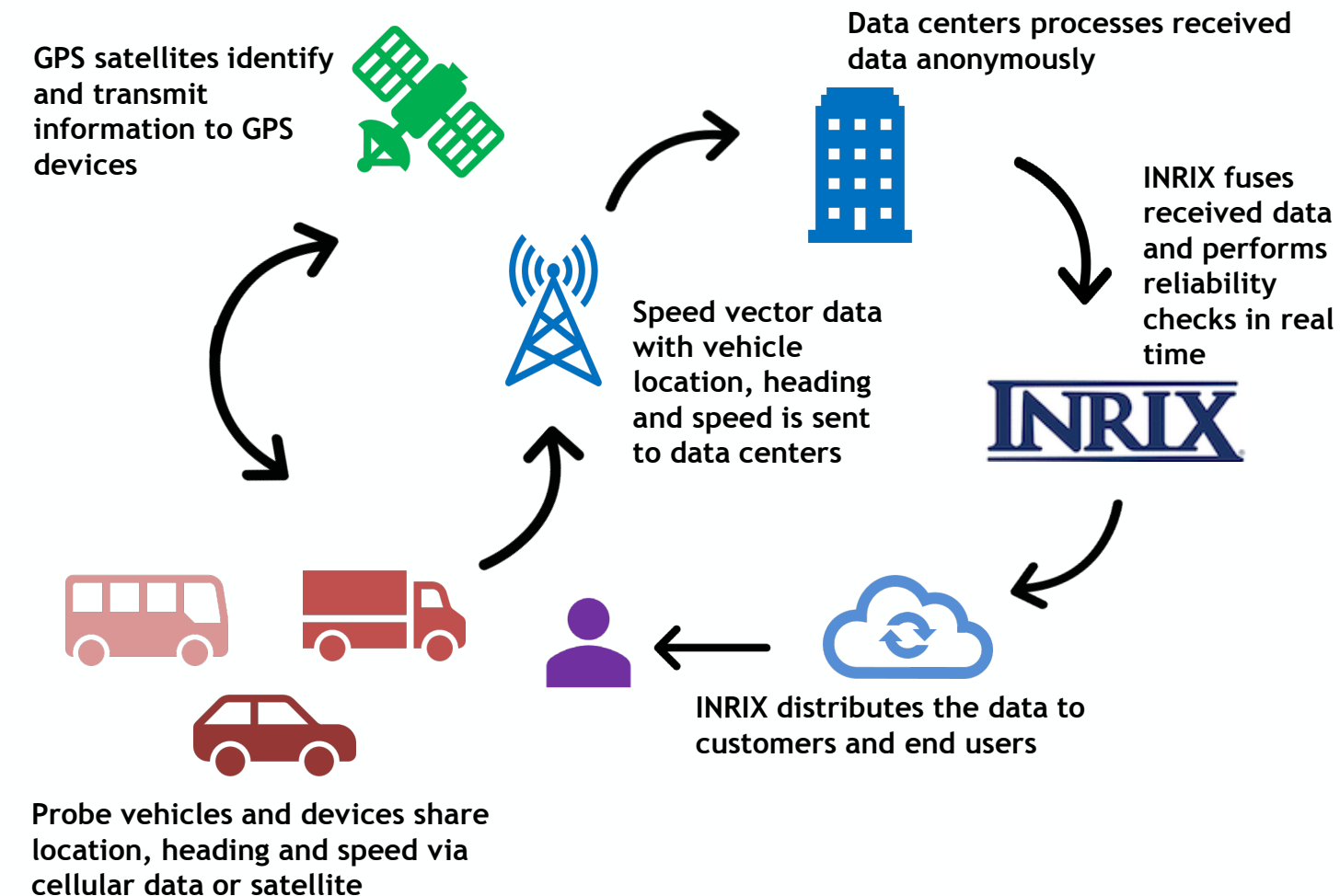
Attractions in Gatlinburg and neighboring Pigeon Forge have disproportionately larger travel times from the nearest airport

Trip analysis using INRIX Trip Analytics: Introduction

How does INRIX collect traffic data?

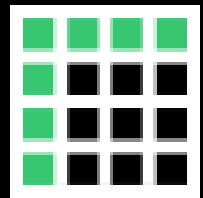
Introduction

- INRIX crowd-sources traffic data from agencies, roadway sensors and cameras, and GPS on cell phones and vehicles.
 - GPS information is identified by satellites and transmitted to probe vehicles and devices
 - GPS location, speed and heading from vehicles and transmitted to data centers
 - Data centers anonymizes the collected and INRIX fuses it together
 - INRIX distributed the data to its users



Trip analysis using INRIX Trip Analytics: Introduction

Components of INRIX Trip Analytics



OD MATRIX

Set up an Origin-Destination matrix by choosing geographies and dates available

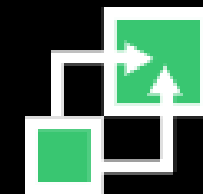
Enables selection of Origins and Destinations for a given period to create an OD Matrix



SEGMENT ANALYSIS

Analyze the different origins and destinations of trips that passed through selected road segments

Enables identification of origins, destinations and trip frequencies for selected highway segment, dates, vehicle types and time of day



ROUTE ANALYSIS

Analyze the routes between different geographies during different dates and time periods

Enables selection of origin and destination to identify most popular routes, travel distance and travel times

Trip analysis using INRIX Trip Analytics: Introduction

Analysis of long-distance trips (LDT) made to major cities

Objectives

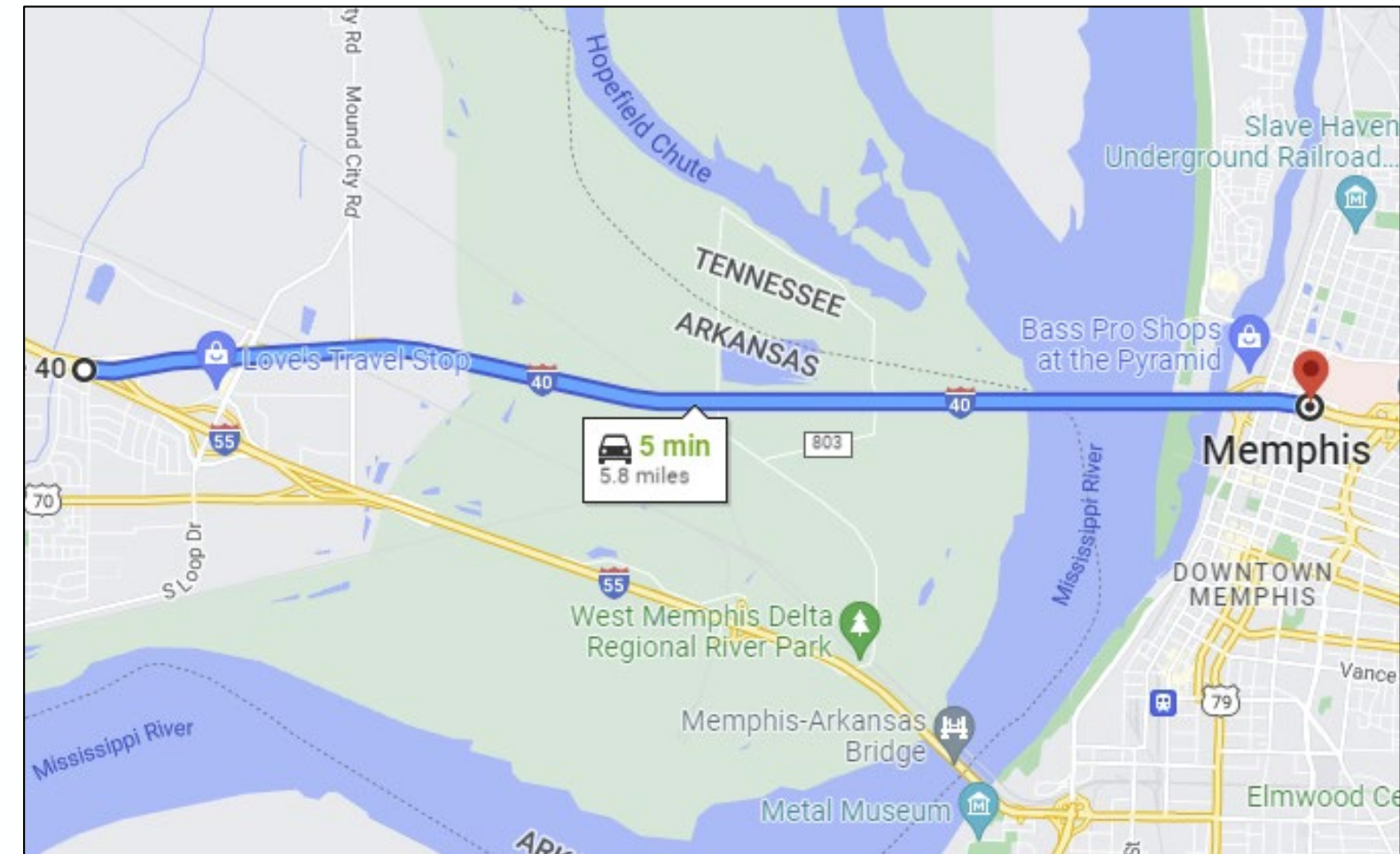
- Analyze daily long-distance trips (LDT) made to major destinations using **Segment Analysis**
 - Memphis
 - Nashville
 - Chattanooga
 - Knoxville
 - Gatlinburg

Approach

- Find average number of daily LDT (>50 mi of travel) made from April 2019 to Aug 2019 through a specific highway segment
- Find AADT on the highway segment
- Find the percentage of LDT

$$\% LDT = \frac{\text{Number of daily LDT trips}}{AADT} * 100$$

Highway segment used for LDT analysis: I-40E (Memphis)



Source: Google Maps <https://goo.gl/maps/yFNe59eaNKNwmhBU9>

Trip analysis using INRIX Trip Analytics: Introduction

INRIX Interface

Analysis of long-distance trips (LDT) made to major cities

Component of the Segment Analysis interface

- 1 Details of the query being run
- 2 Main component of the interface that facilitates selection of segment, trips (by vehicle types) and time of day
- 3 Dropdown menu for selection of highway segments
- 4 Spatial resolution of the query. This can be county, subcounty, TAZ or ZIP level
- 5 Customizable map legend used for trip frequency
- 6 Options to view and save output matrix for the query
- 7 Map showing result from the query

Segment Analysis

Using the [Tennessee data set](#)

I-40 Eastbound between Club Rd/Southland Dr/Exit 280 and TN-14/TN-3/2Nd St/Exit 1; County to County; Vehicle type: Light, Medium; Started and ended: April, May, June, July and August 2019, Monday, Tuesday, Wednesday, Thursday and Friday, 6 AM - 9 AM

Map Controls **Trip Filters** **Time Range**

Road Selection

Search for road...

Your selected roads Remove all

I-40 Eastbound between Club Rd/Southland...

Directions:

☒ Eastbound ☐ Westbound

☐ Entire (784 interchanges) ☒ Partial

From: Intersection

CLUB RD/SOUTHLAND DR/EXIT 280

To: Intersection

TN-14/TN-3/2ND ST/EXIT 1

5.83 miles of roadway selected (11 segments)

Data is returned only for trips that travelled all selected road segments.

Geographic resolution

County

For trips through selected road segment, show the...

☒ Origins and destinations

☐ Origins

☐ Destinations

Data appearance

☐ Show values on map

Color legend...

☐ Enter exact values

☐ Hide lowest color range

Origins

Destinations

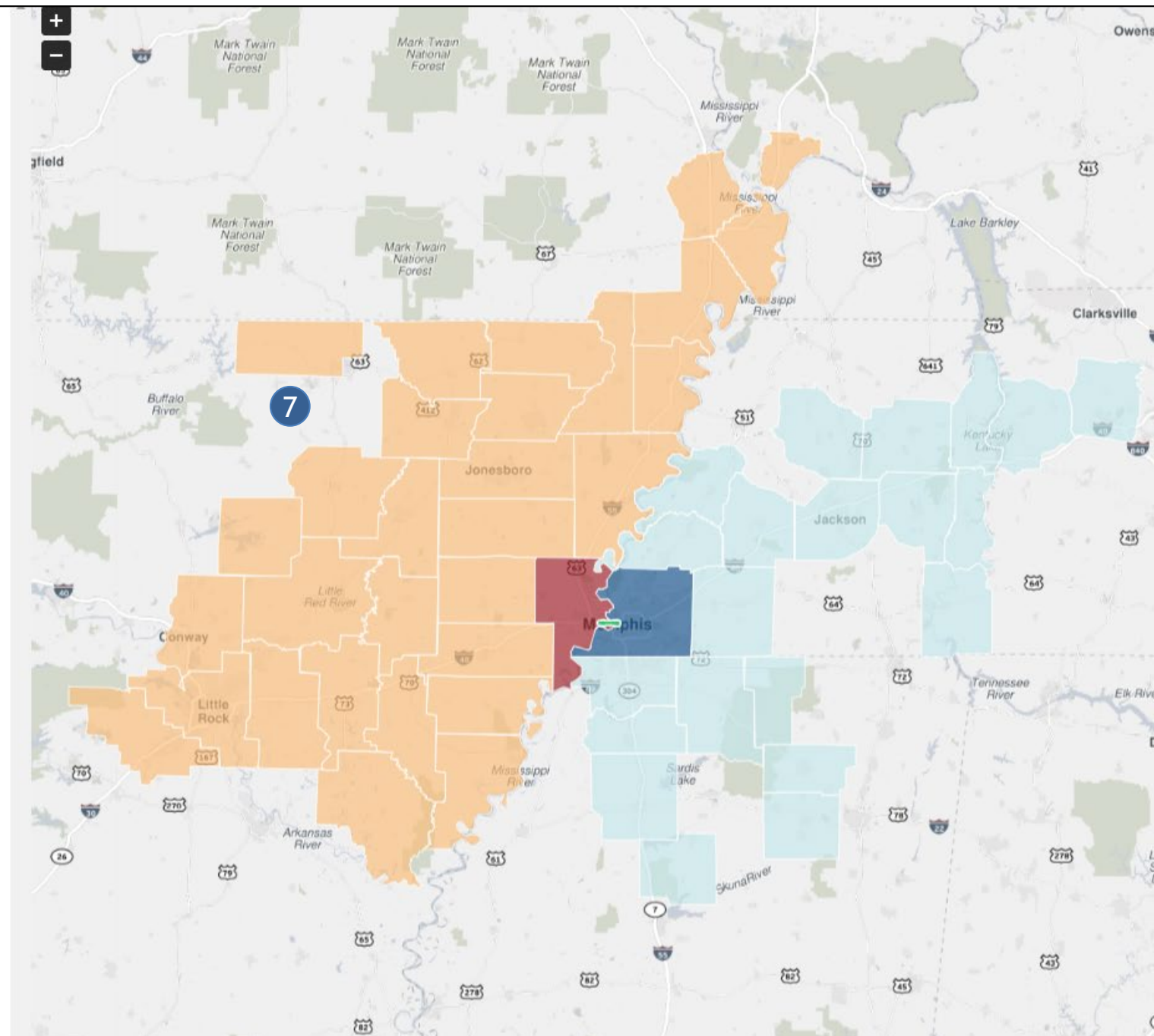
1396

2791

4188

5581

View Matrix **Submit**



Trip analysis using INRIX Trip Analytics: Results

LDT through I-40E (Memphis)

Your selected roads 1 Remove all ✕

► I-40 Eastbound between Club Rd/Southlan... ■ ✕

Directions:
☒ Eastbound ☐ Westbound
☐ Entire (784 interchanges) ☒ Partial

From: Intersection
CLUB RD/SOUTHLAND DR/EXIT 280 ▼

To: Intersection
TN-14/TN-3/2ND ST/EXIT 1 ▼

5.83 miles of roadway selected (11 segments) 1

Data is returned only for trips that travelled **all** selected road segments.

Geographic resolution
County ▼

For trips through selected road segment, show the...

☒ Origins and destinations
☐ Origins
☐ Destinations

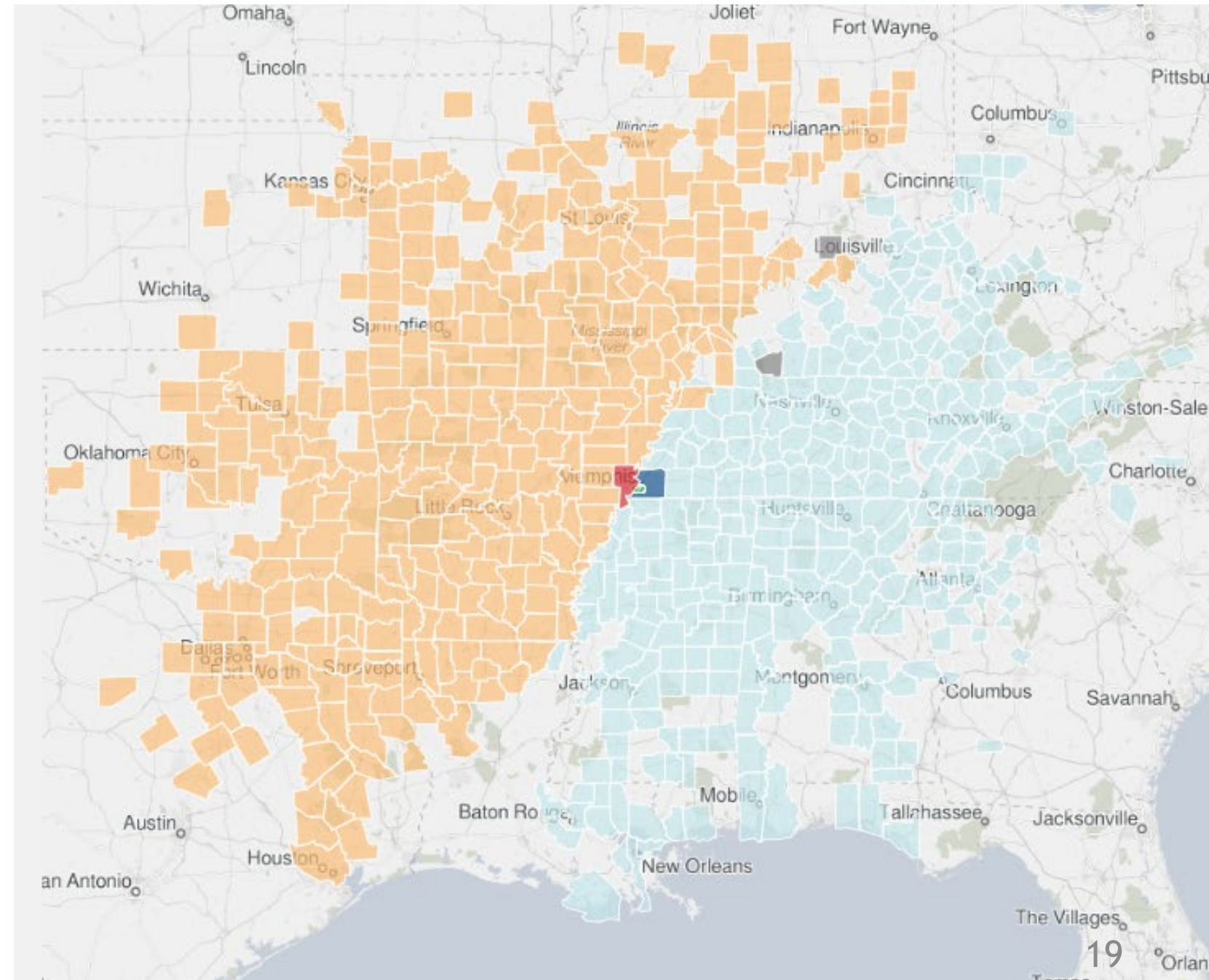
Data appearance
☐ Show values on map 1

Color legend...

☒ Enter exact values
☐ Hide lowest color range

Origins
Destinations

25000 50000 70000 100000



Trip analysis using INRIX Trip Analytics: Results

LDT through I-40E (Nashville)

Road Selection

Your selected roads

Remove all

▶
I-40 Eastbound between Davidson/Cheatha...

Directions:

☒ Eastbound
☐ Westbound

☐ Entire (784 interchanges)
☒ Partial

From: Intersection

DAVIDSON/CHEATHAM COUNTY LINE

To: Intersection

TN-251/OLD HICKORY BLVD/EXIT 199

7.91 miles of roadway selected (7 segments)

Data is returned only for trips that travelled **all** selected road segments

Geographic resolution

County

For trips through selected road segment, show the...

☒ Origins and destinations
☐ Origins
☐ Destinations

Data appearance

☐ Show values on map

Color legend...

☒ Enter exact values
☐ Hide lowest color range

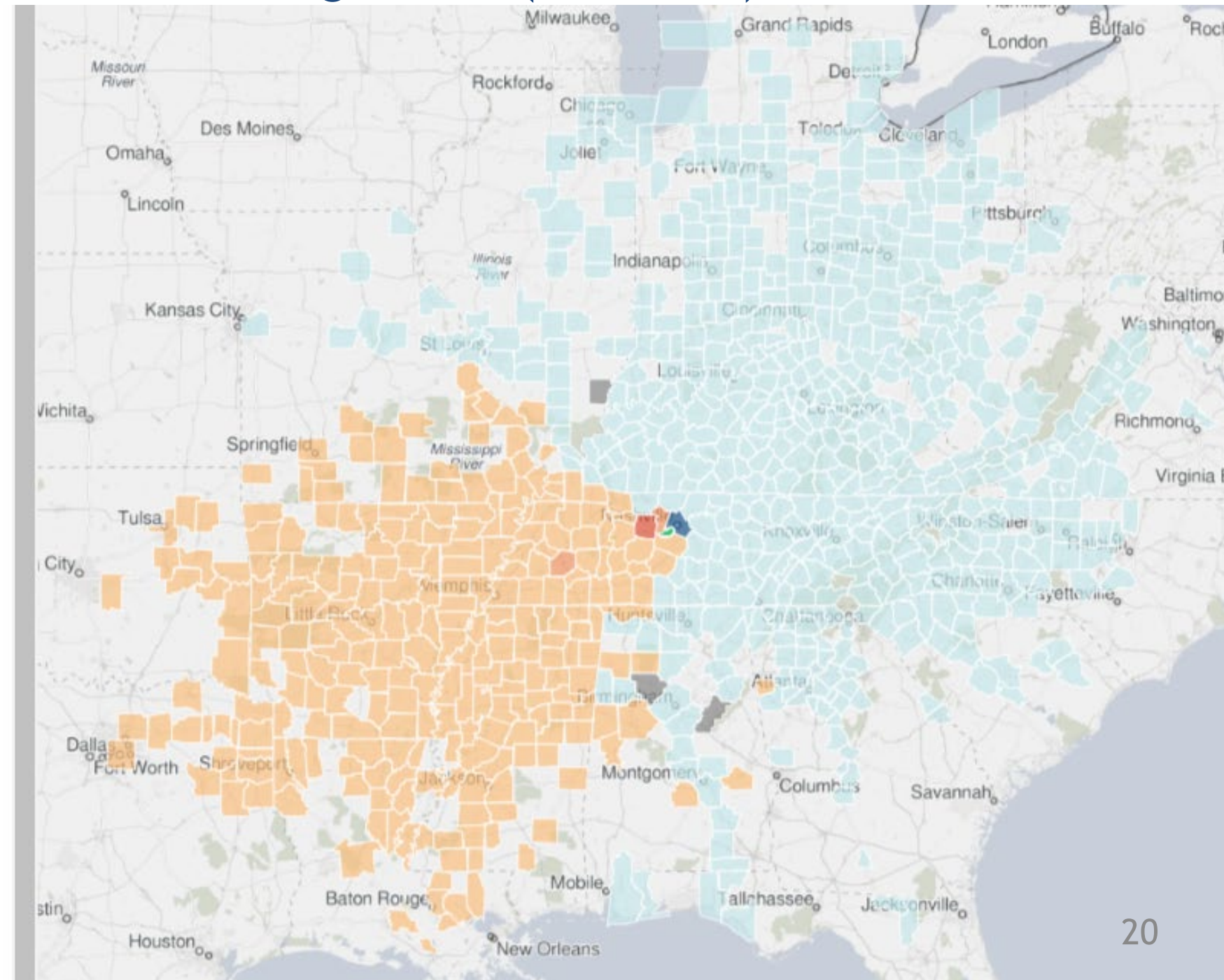
Origins
Destinations

50000

125000

200000

275000



Trip analysis using INRIX Trip Analytics: Results

LDT through I-40E (Chattanooga)

Road Selection

Search for road...

Your selected roads 1 Remove all

► I-24 Eastbound between US-41/US-64/US-... 2 I-24 Eastbound between US-41/US-64/US-72/TN-2/Exit 174 and Browns Ferry Rd/Exit 175

Directions:

☒ Eastbound ☐ Northbound
☐ Southbound ☐ Westbound

☐ Entire (44 interchanges) ☒ Partial

From: Intersection
US-41/US-64/US-72/TN-2/EXIT 174

To: Intersection
BROWNS FERRY RD/EXIT 175

4.38 miles of roadway selected (5 segments)

Data is returned only for trips that travelled all selected road segments.

Geographic resolution
County

For trips through selected road segment, show the...

☒ Origins and destinations
☐ Origins
☐ Destinations

Data appearance

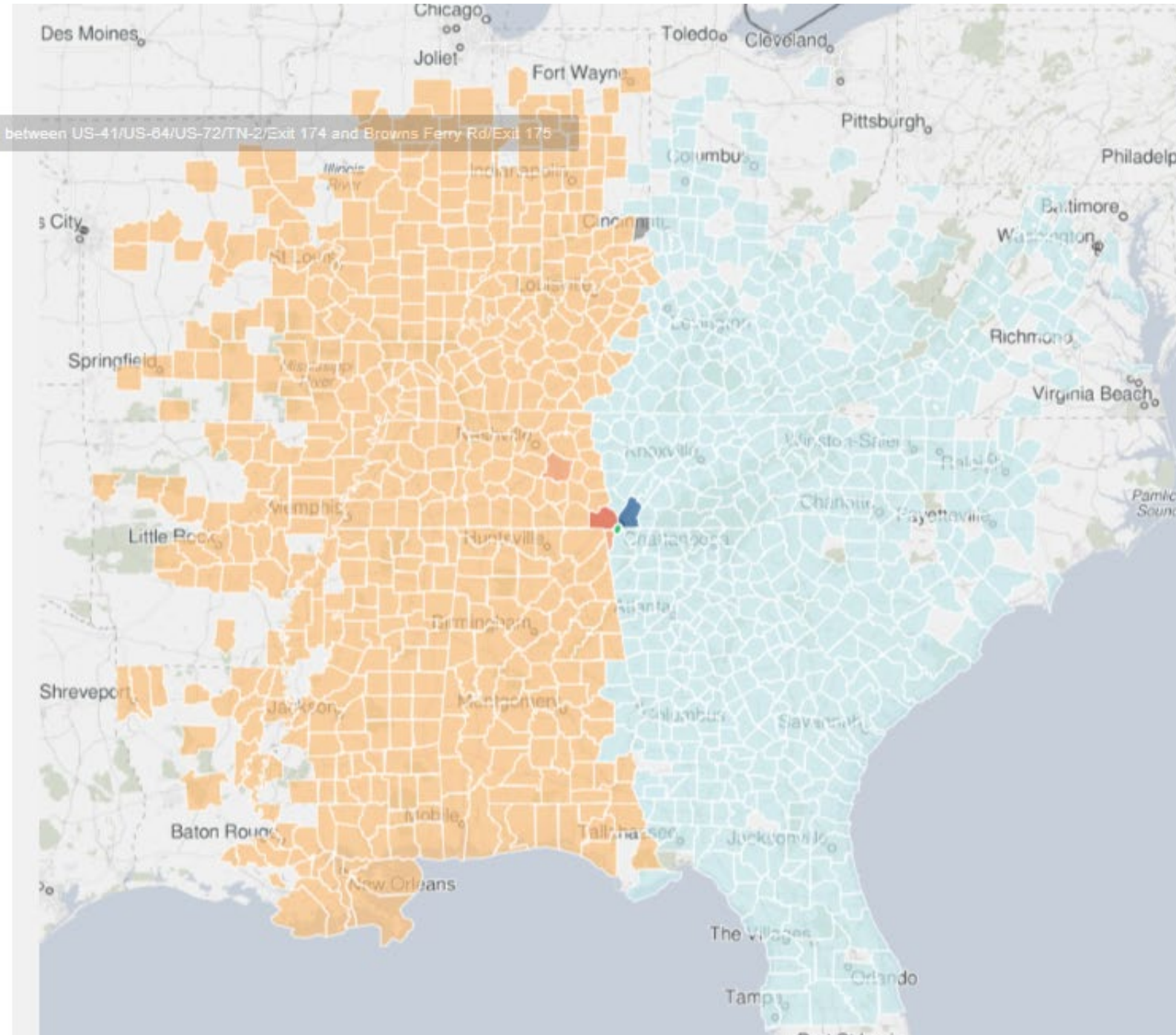
☐ Show values on map

Color legend...

☒ Enter exact values
☐ Hide lowest color range

Origins
Destinations

75000 175000 250000 350000



Trip analysis using INRIX Trip Analytics: Results

LDT through I-40E (Knoxville)

Road Selection

Search for road...

Your selected roads 1 Remove all ✕

► I-40 Eastbound between I-75/I-40/Exit 368 ... ■ ✕

Directions:

☒ Eastbound ☐ Westbound

☐ Entire (784 interchanges) ☒ Partial

From: Intersection

I-75/I-40/EXIT 368 ▼

To: Intersection

I-75/I-40/EXIT 368 ▼

4.04 miles of roadway selected (2 segments) 1

Data is returned only for trips that travelled **all** selected road segments.

Geographic resolution

County ▼

For trips through selected road segment, show the...

☒ Origins and destinations

☐ Origins

☐ Destinations

Data appearance

☐ Show values on map 1

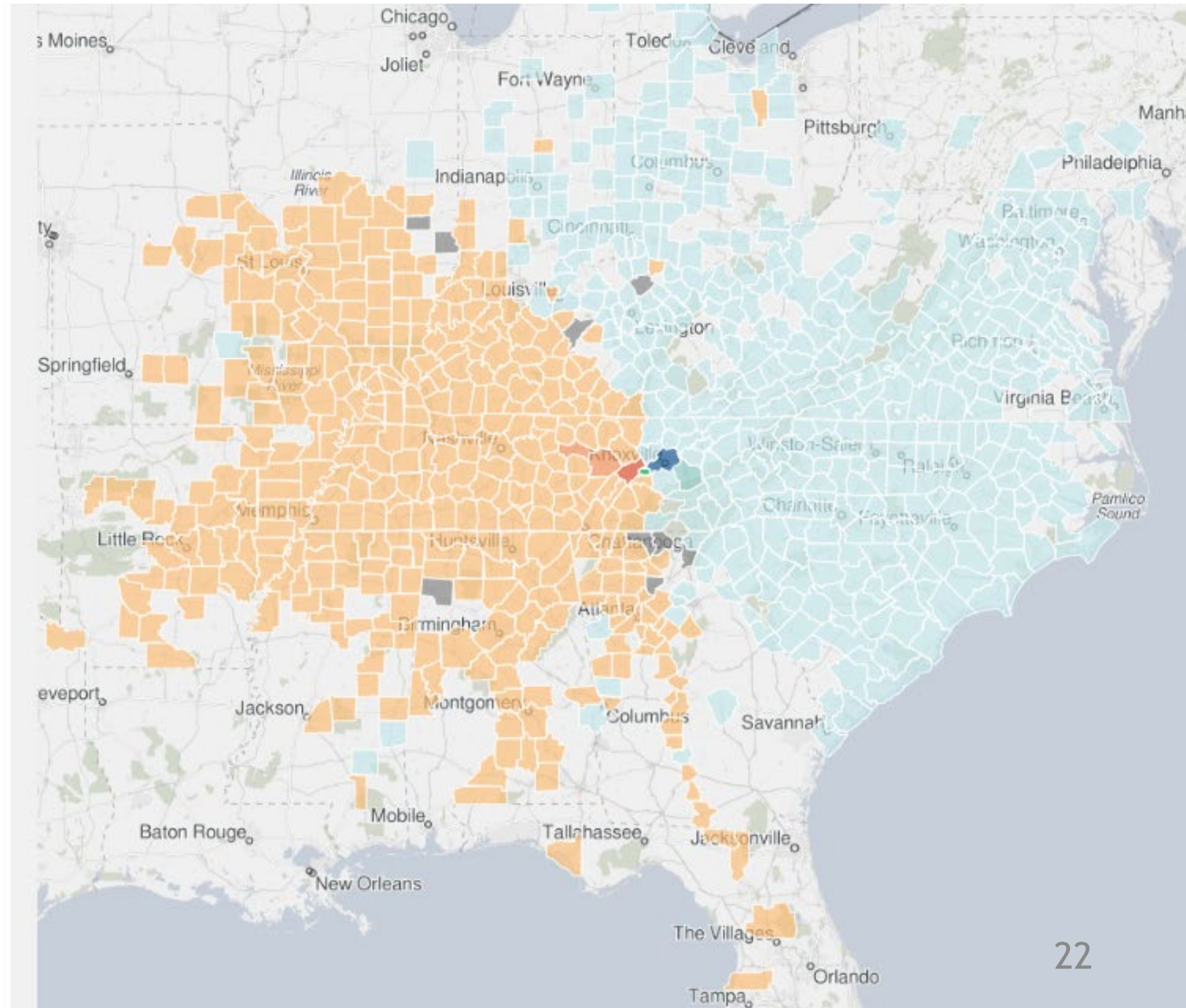
Color legend...

☒ Enter exact values

☐ Hide lowest color range

Origins 75000 150000 225000 300000

Destinations 75000 150000 225000 300000



Trip analysis using INRIX Trip Analytics: Results

LDT through US-321S (Gatlinburg)

Road Selection

Search for road...

Your selected roads 1 Remove all ✕

► US-321 Eastbound between Gatlinburg By... ■ ✕

Directions:
☒ Eastbound ☐ Westbound

☐ Entire (68 interchanges) ☒ Partial

From: Intersection
GATLINBURG BYP/PARKWAY BYP ▼

To: Intersection
GATLINBURG BYP/PARKWAY BYP ▼

7.49 miles of roadway selected (2 segments) 1

Data is returned only for trips that travelled **all** selected road segments.

Geographic resolution
County ▼

For trips through selected road segment, show the...

☒ Origins and destinations
☐ Origins
☐ Destinations

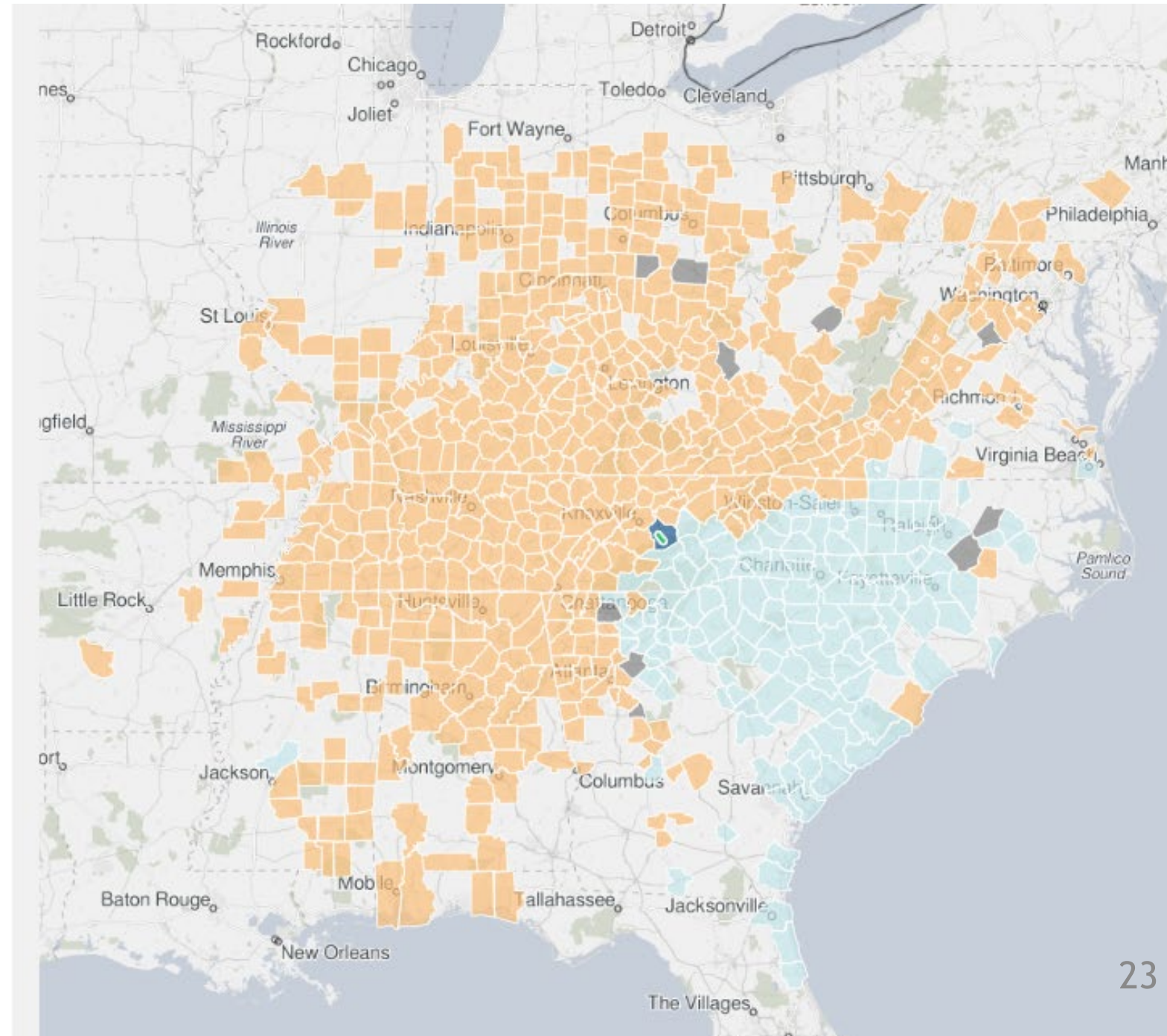
Data appearance
☐ Show values on map 1

Color legend...

☐ Enter exact values
☐ Hide lowest color range

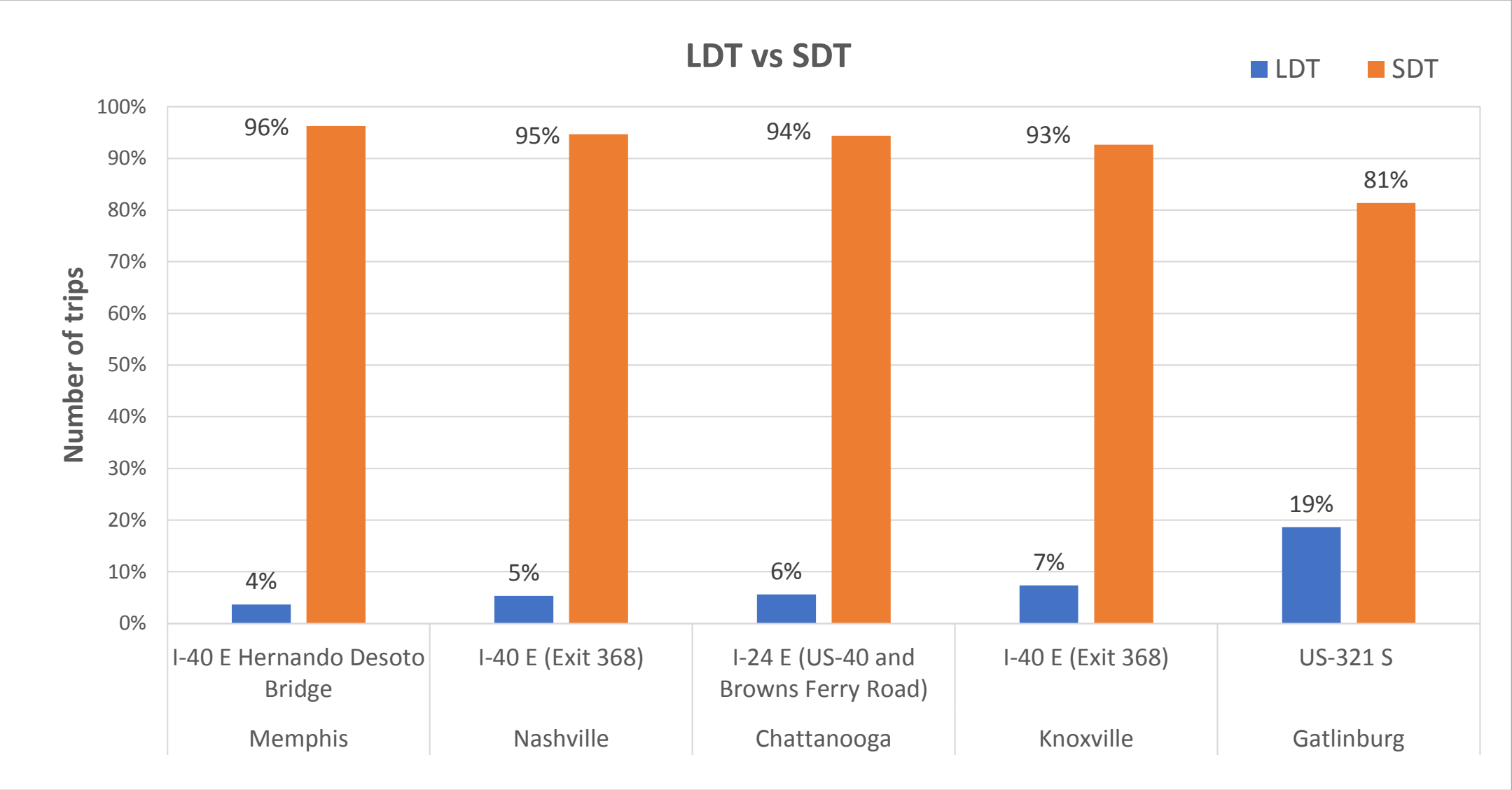
Origins
Destinations

150000 300000 450000 600000



Conclusion

Daily LDT vs AADT



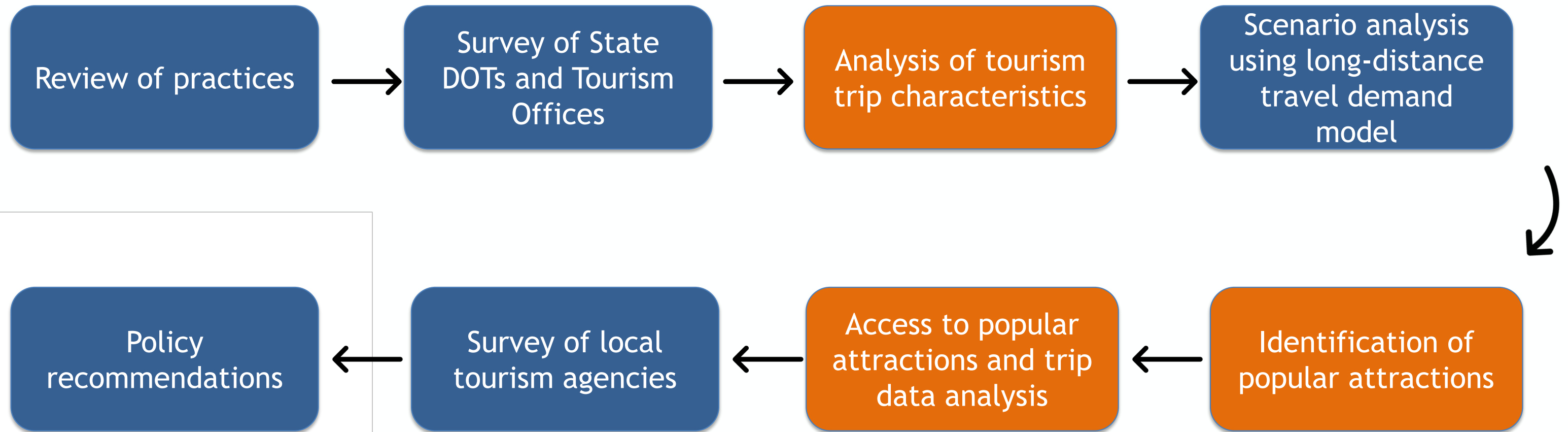
Key takeaways

- About 4-8% trips through the segments were found to be long-distance trips
- Proportion of LDT trips traveling to Gatlinburg are considerably higher than other cities

LDT = Long-distance trip
SDT = Short-distance trips

Conclusion

Project deliverables



 Parts of deliverables presented in today's session

Acknowledgement

This study was funded by the Tennessee Department of Transportation and Federal Highway Administration through the State Planning and Research (SPR) Program under ***RES 2021-02: Towards Sustainable Tourism Transportation Systems and Services in Tennessee.***

Questions?

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