The background of the slide is an aerial photograph of a park in Knoxville, Tennessee. The park features large green lawns, several clusters of trees with autumn-colored leaves (yellow, orange, red), and a small white building with a gabled roof. A paved path or road curves through the park. In the distance, more trees and buildings of a residential or urban area are visible under a clear sky.

Professional Science Master's in Environmental Informatics

Determining COVID-19's Impact on Visitors' Willingness to Travel to  
Lakeshore Park and Victor Ashe Park in Knoxville, Tennessee, through  
an Ordinary Least Squares Regression Model

Chantelle M. Rittmaier

Contributions from S. Carter Christopher, Gautam M. Thakur, Marie L. Urban, and Sarah E. Walters

Oak Ridge National Laboratory  
Human Dynamics, 1 Bethel Valley Rd., Oak Ridge, TN 37830

December 2022

## 2020 COVID-19 Pandemic

# COVID-19 Pandemic

- ▶ Infectious disease that began to spread in early 2020
- ▶ Symptoms ranged drastically between people with no consistent pattern between age, race, sex, or other factors
  - ▶ Asymptomatic
  - ▶ Mild: Cold-like symptoms (fever, cough, chills, etc.)
  - ▶ Severe: Often required special treatments, hospitalizations, and possibly death
- ▶ All age groups are affected
- ▶ The last pandemic that the world experienced was the 1918 influenza pandemic
  - ▶ Estimated that 1/3<sup>rd</sup> of the world's population became infected with this virus



Reuters

## 1918 Influenza Pandemic



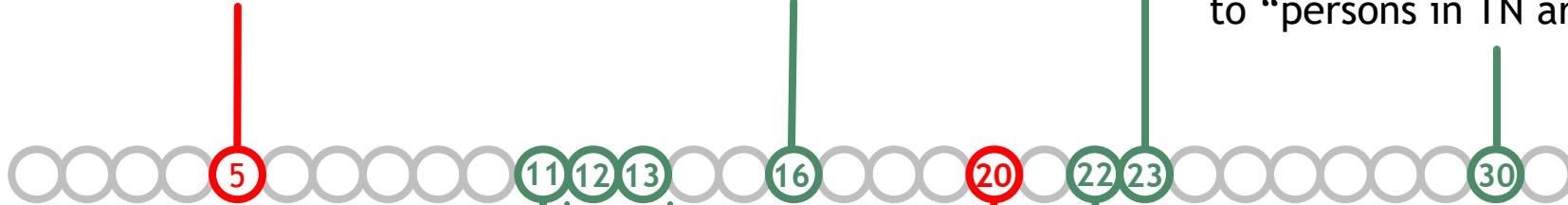
The Guardian

# Tennessee COVID-19 Executive Orders

## March 2020



First COVID-19 case in TN announced

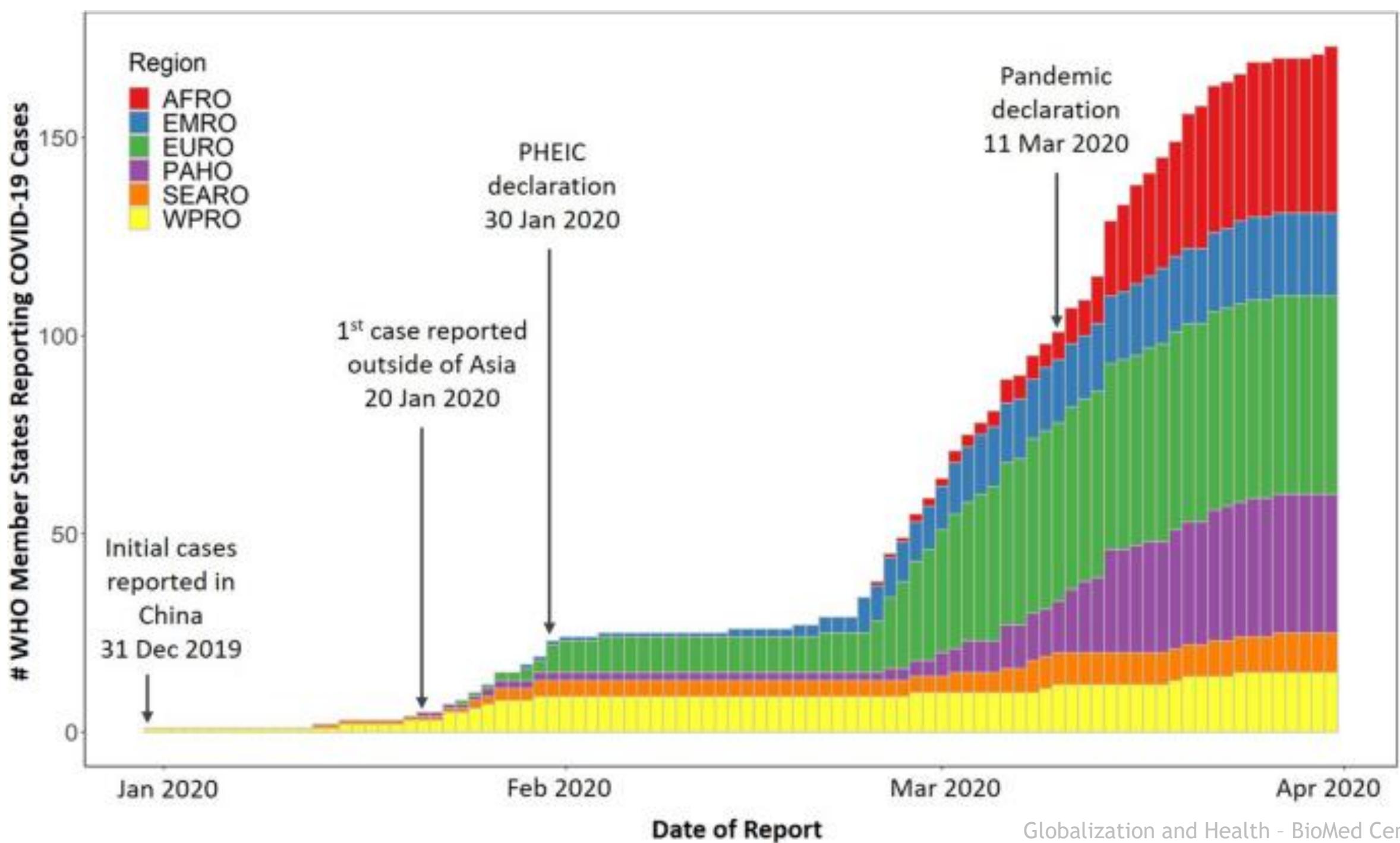


World Health Organization declared COVID-19 a global pandemic

Executive order issued to close restaurants, bars, gyms, and event venues

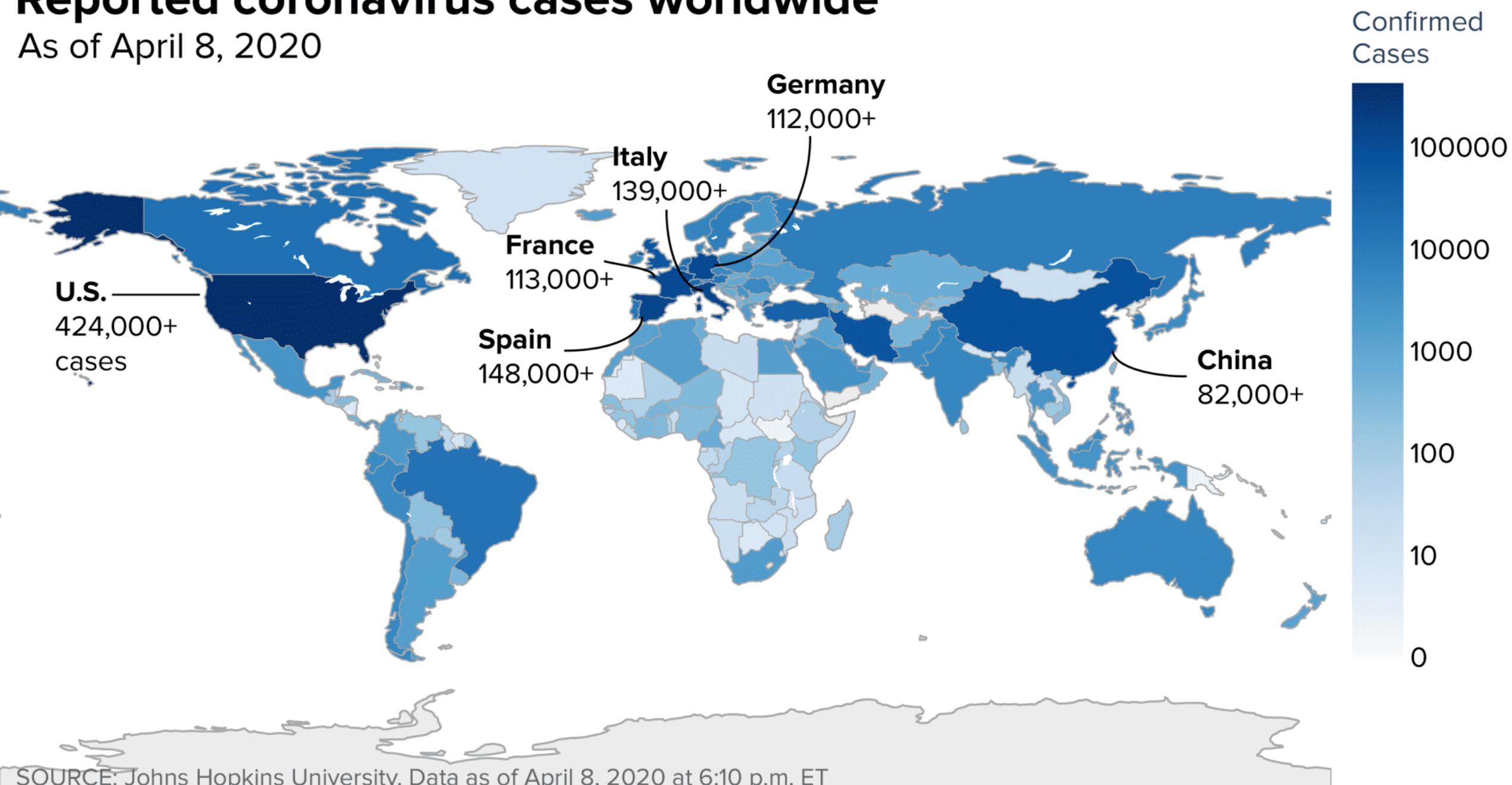
First COVID-19 related death in Tennessee





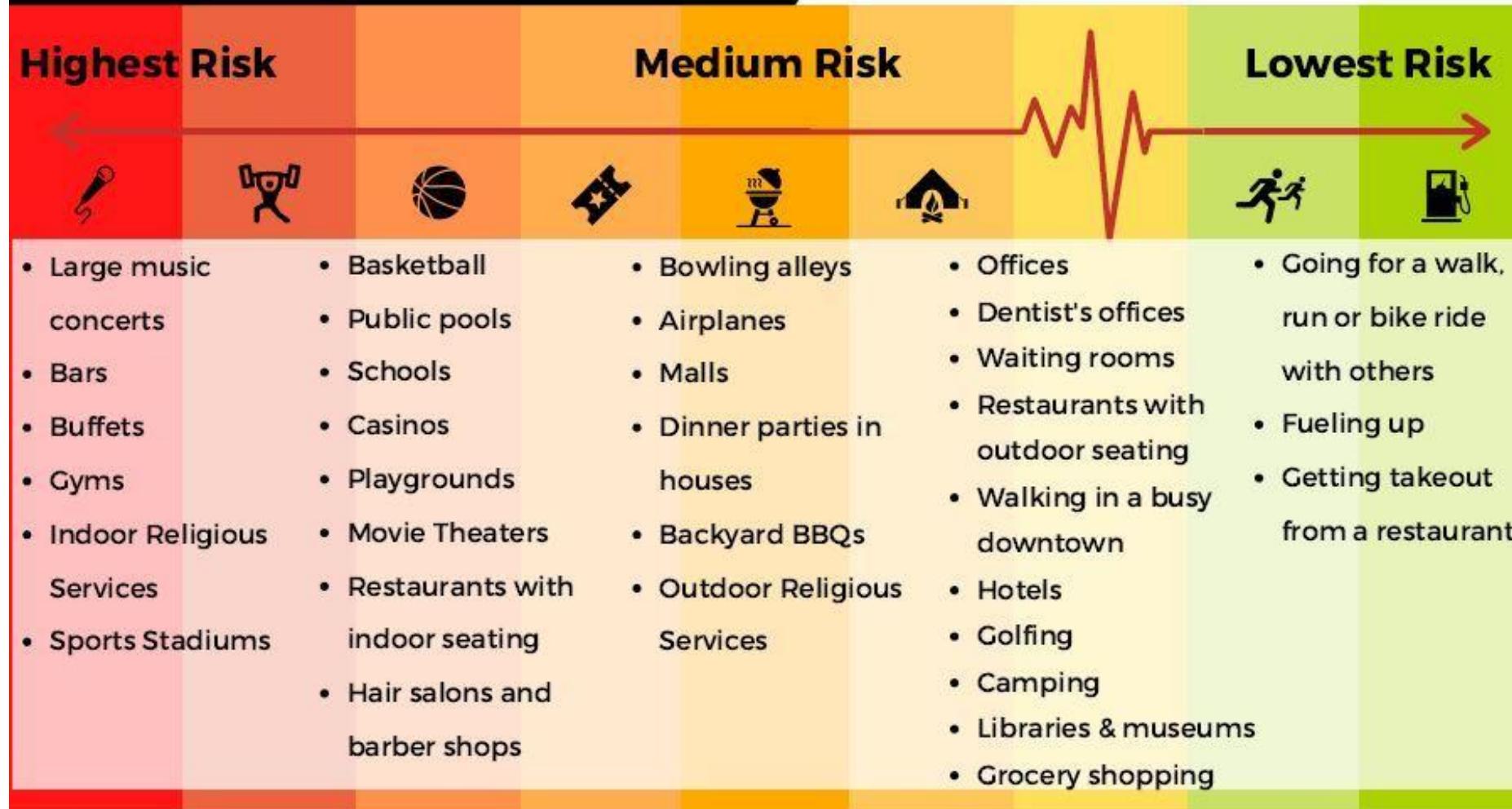
# Reported coronavirus cases worldwide

As of April 8, 2020



# What's the Risk?

We're all concerned about spreading COVID-19 in our community.  
Want to know how risky certain behaviors are?

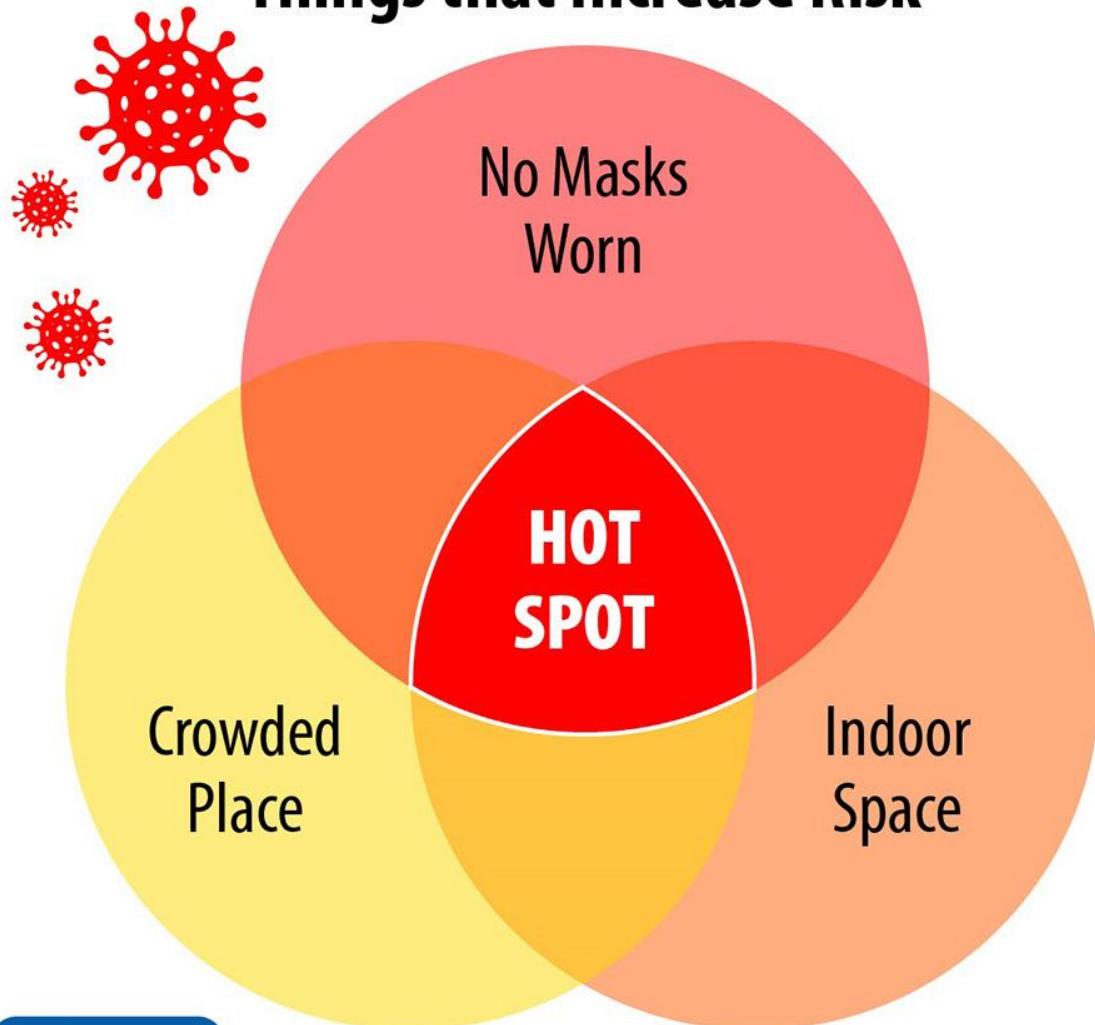


Always remember to wear a mask,  
stay home if you're sick,  
and stay at least six feet apart from others.

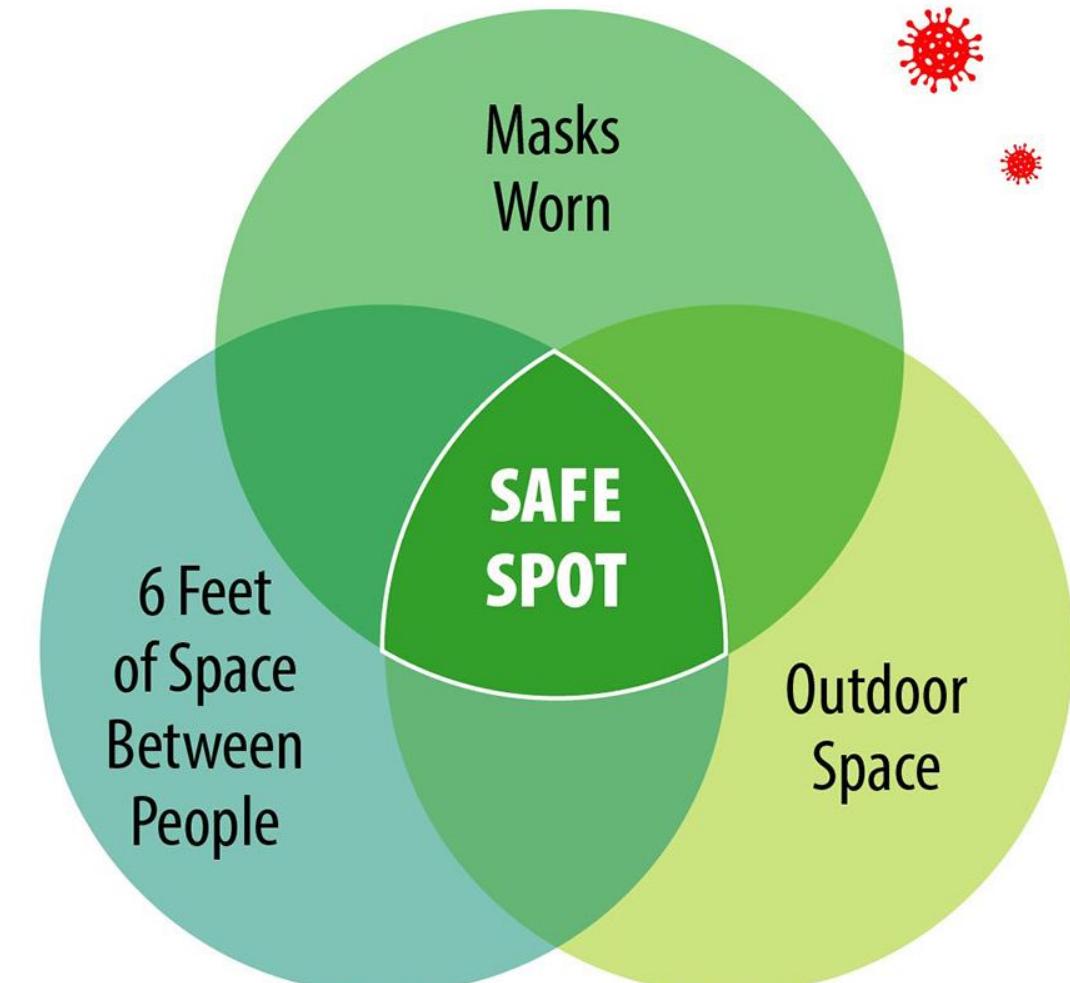


# Tips for Reducing Risk of Getting COVID-19

## Things that Increase Risk



## Things that Decrease Risk



# COVID-19 Impact on Park Visitation

- ▶ Outdoor spaces became an essential location
  - ▶ Social distancing could be effectively practiced
  - ▶ Less fears of spreading and/or catching COVID-19
- ▶ Parks all around the world saw an increase of visitors during the pandemic
- ▶ Many studies saw a significant increase in park visitation as high as 63.4% with the onset of the pandemic (Volenec et al., 2021)

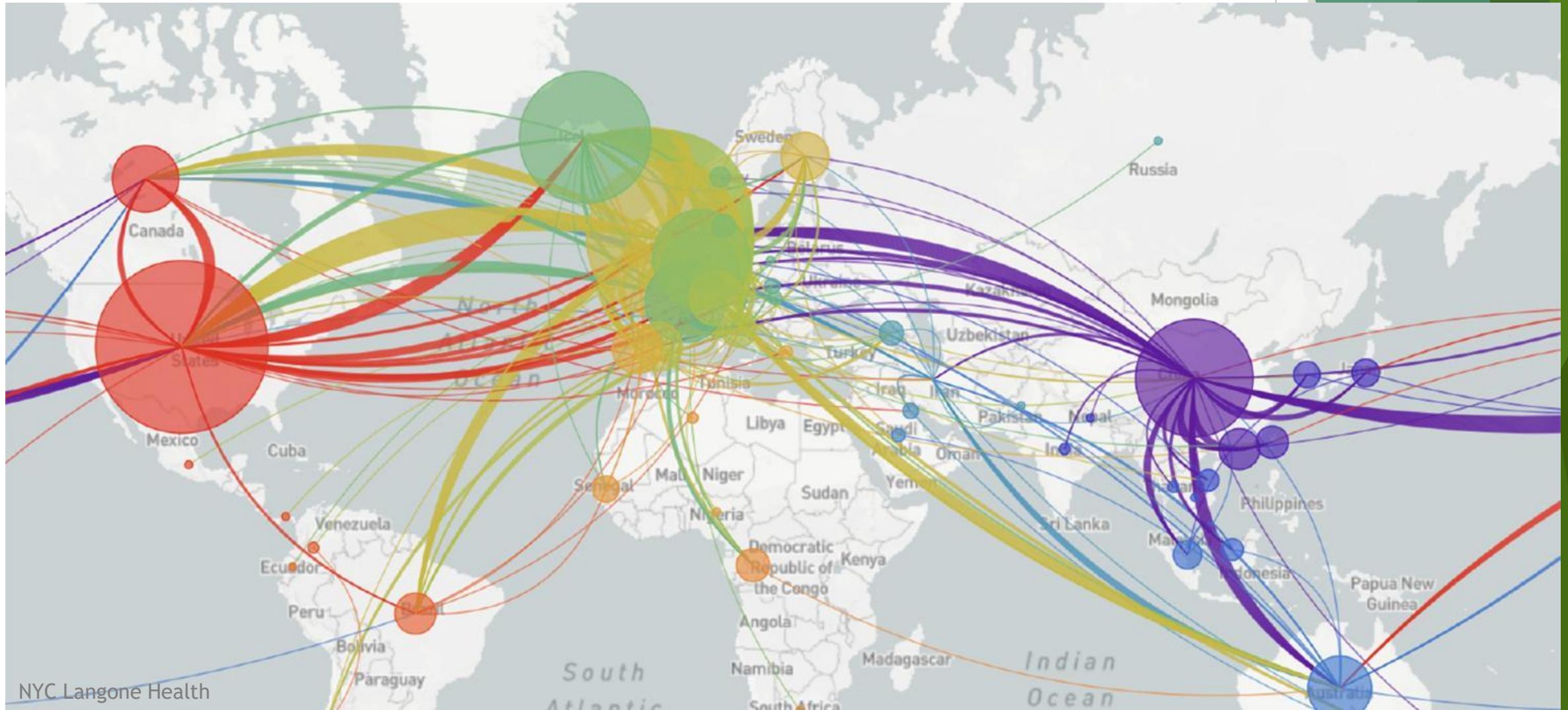
# Capstone Project Goal

- ▶ Analyze the effect COVID-19 had on the distance that people were willing to travel to parks
- ▶ Study Areas: two parks in Knoxville, Tennessee with similar characteristics
  - ▶ Lakeshore Park
  - ▶ Victor Ashe Park
- ▶ Time Frame: November 2018 to November 2020

# Importance of understanding how people's movement was affected by a global pandemic

- ▶ Origin-endpoint datasets provide a method to analyze human mobility patterns at various scales via cell-phone position data
- ▶ COVID-19 quickly became a unique opportunity to study how human mobility patterns were affected on a global scale
  - ▶ Officials could use origin-endpoint datasets to:
    - ▶ Predict what locations would experience a rise in infectious disease outbreaks
    - ▶ The effects government measures have on reducing COVID-19 related deaths
- ▶ Also, beneficial to inform different fields such as transportation forecasting, real estate planning, or overall population dynamics

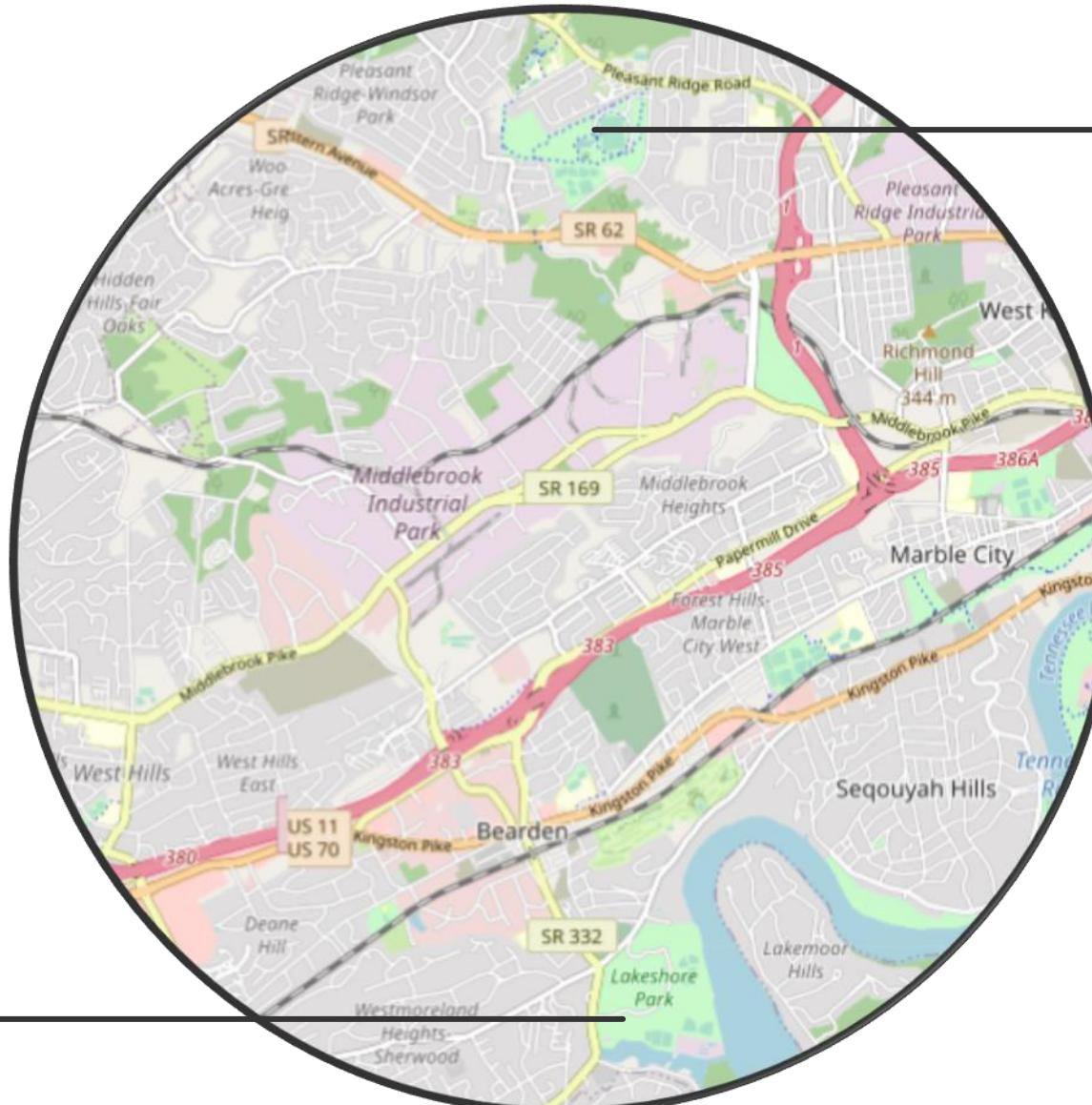
# NYU Langone Scientists Track Evolution of Coronavirus



# Study Area

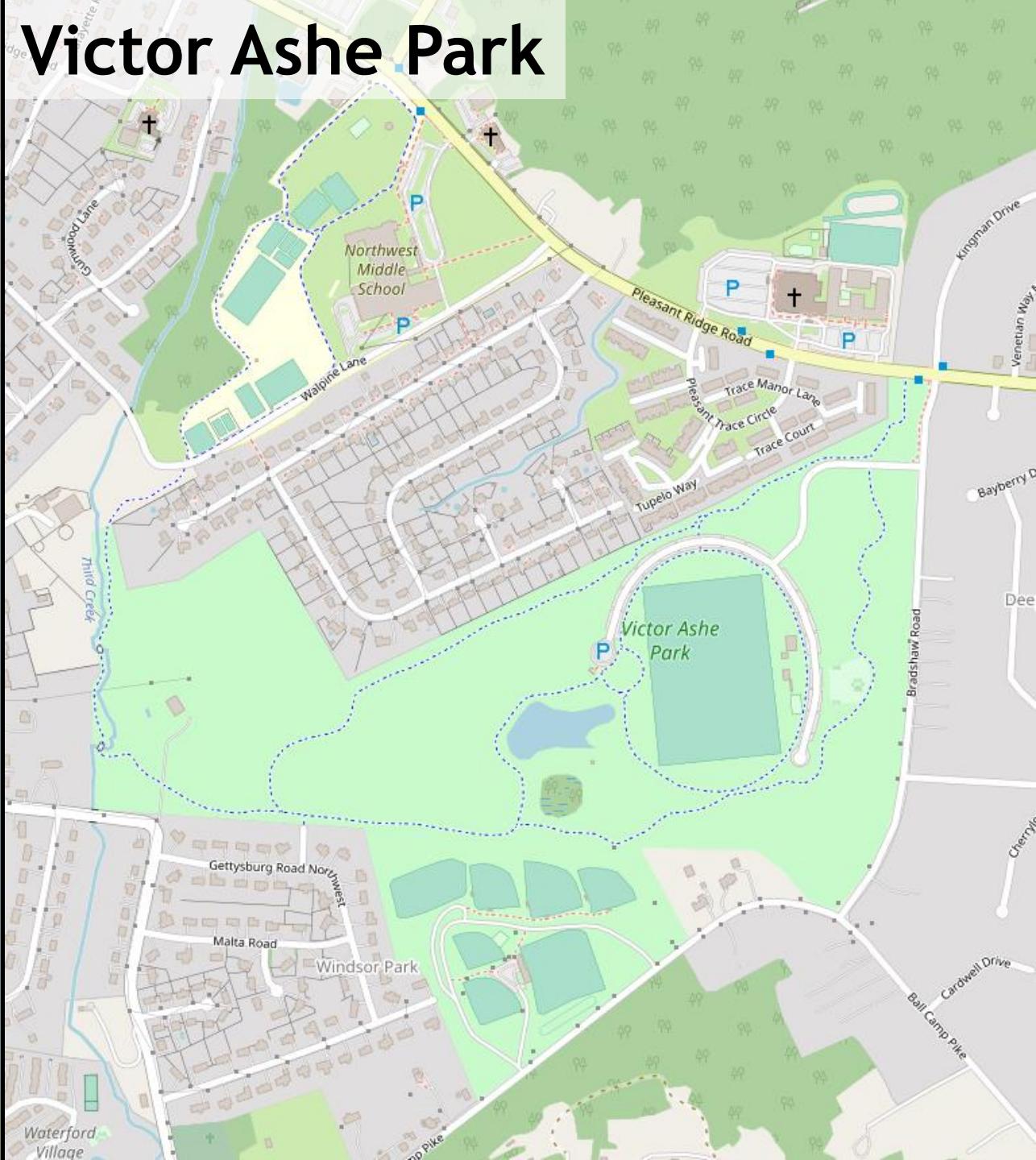
## Lakeshore Park

- ▶ 207.49 Acres
- ▶ 800 Parking Spaces
- ▶ 3.1 Miles of Greenway
- ▶ Amenities include playgrounds, baseball/softball fields, soccer fields, and concession stands
- ▶ Views of Fort Loudon Lake and the Smoky Mountains



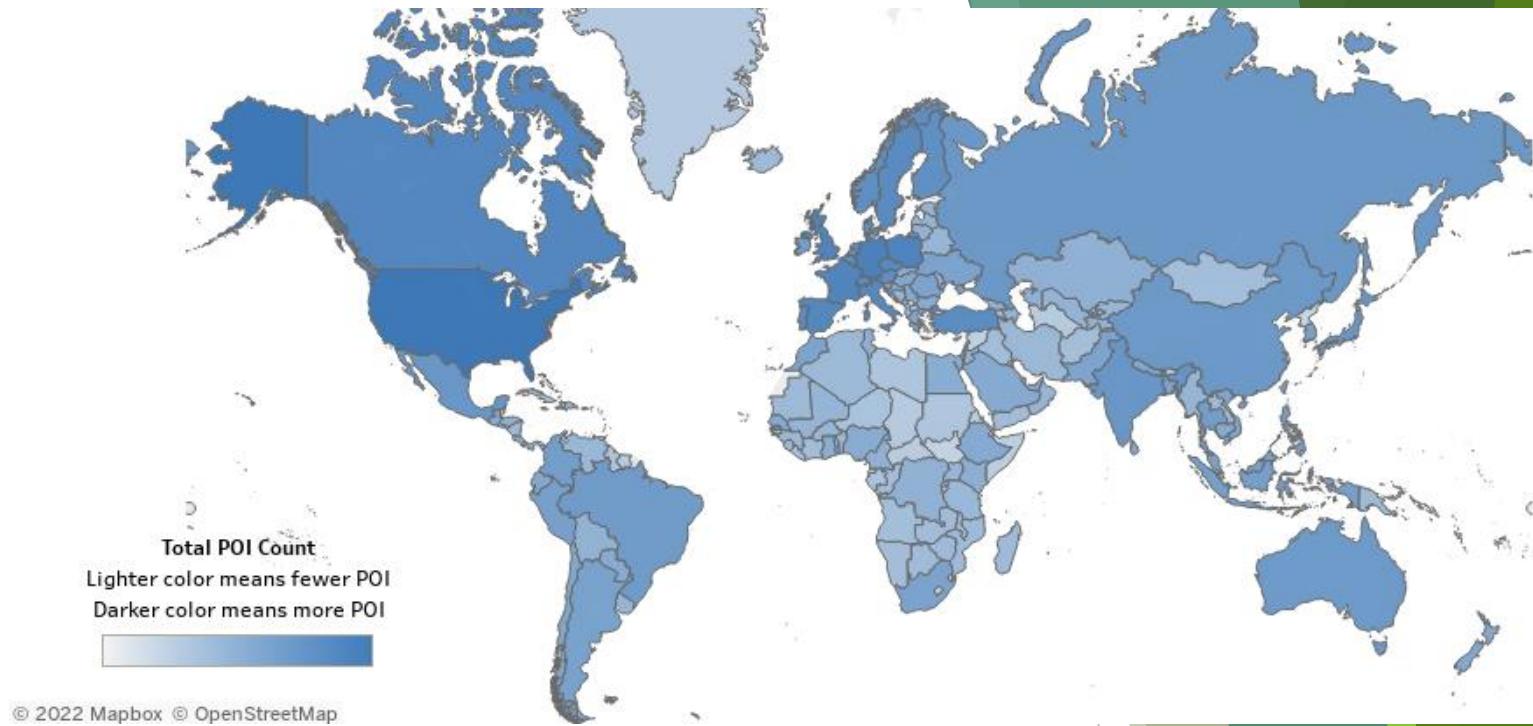
## Victor Ashe Park

- ▶ 115.9 Acres
- ▶ 330 Parking Spaces
- ▶ 2.3 Miles of Greenway
- ▶ 1.5 Miles of Unpaved Trails
- ▶ Amenities include playgrounds, an 18-hole disc golf course, soccer fields, volleyball courts, and concession stands



# SafeGraph Weekly Patterns

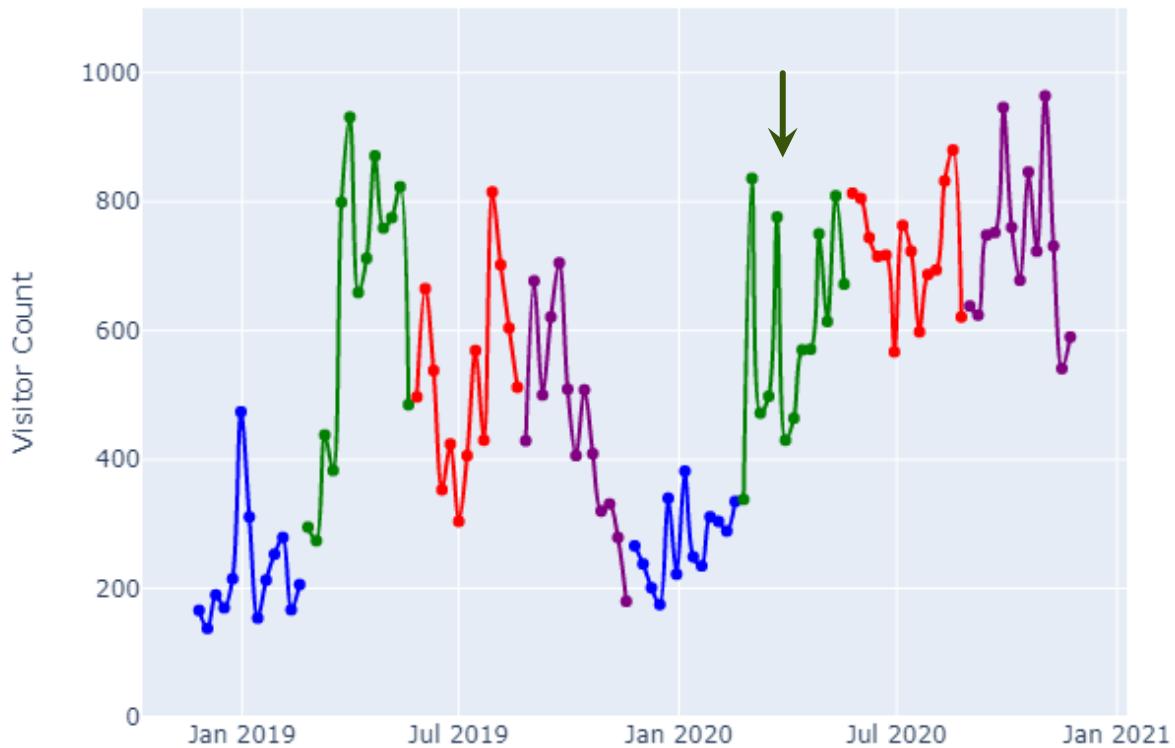
- ▶ SafeGraph curates' global points of interest with detailed attributions, hours of operation, the type of place, and how people interact with that location
- ▶ Provides “traffic” data on a weekly time scale that can also be viewed on an hourly time
- ▶ Total POIs: 31,569,851 (as of 10/22)
- ▶ Data is obtained by pinging 18 million smartphones with certain apps data is then aggregated and anonymized



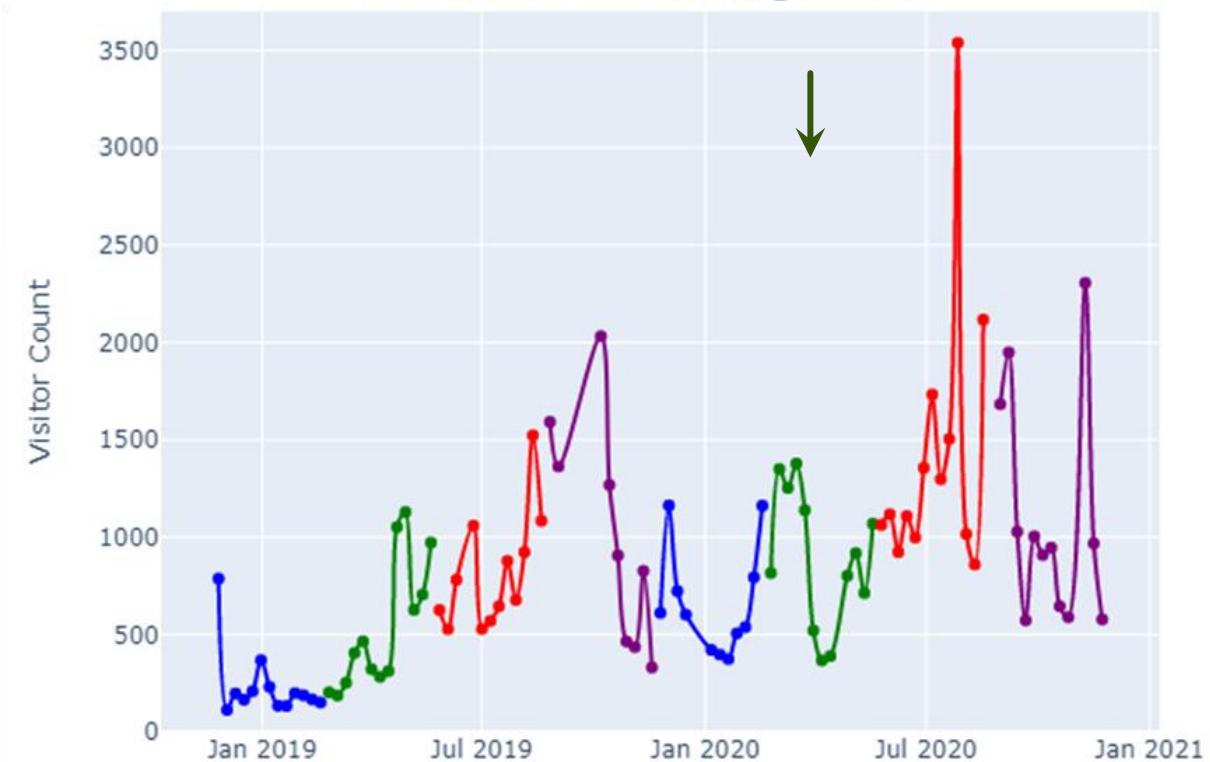
<input checked="" type="checkbox"/> visitor_home_cbgs	The number of visitors to the POI from each census block group or dissemination area based on the visitor's home location. See <a href="#">visitor home cbgs</a> .	JSON {String: Integer}	{"360610112021": 603, "460610112021": 243, "560610112021": 106, "660610112021": 87, "660610112021": 51}
bucketed_dwell_times	The distribution of visit dwell times based on pre-specified buckets. Key is the range of dwell time in minutes and value is number of visits that were within that range. See <a href="#">bucketed dwell times</a> .	JSON {String: Integer}	{ "<5": 40, "5-20": 22, "21-60": 45, "61-240": 3, ">240": 5 }

# Visitation Rates by Season

Lakeshore Park SafeGraph Seasonal Visitation  
Pre-COVID and During COVID



Victor Ashe Park SafeGraph Seasonal Visitation Rates  
Pre-COVID and During COVID



—●— Winter

November  
December  
January

—●— Spring

February  
March  
April

—●— Summer

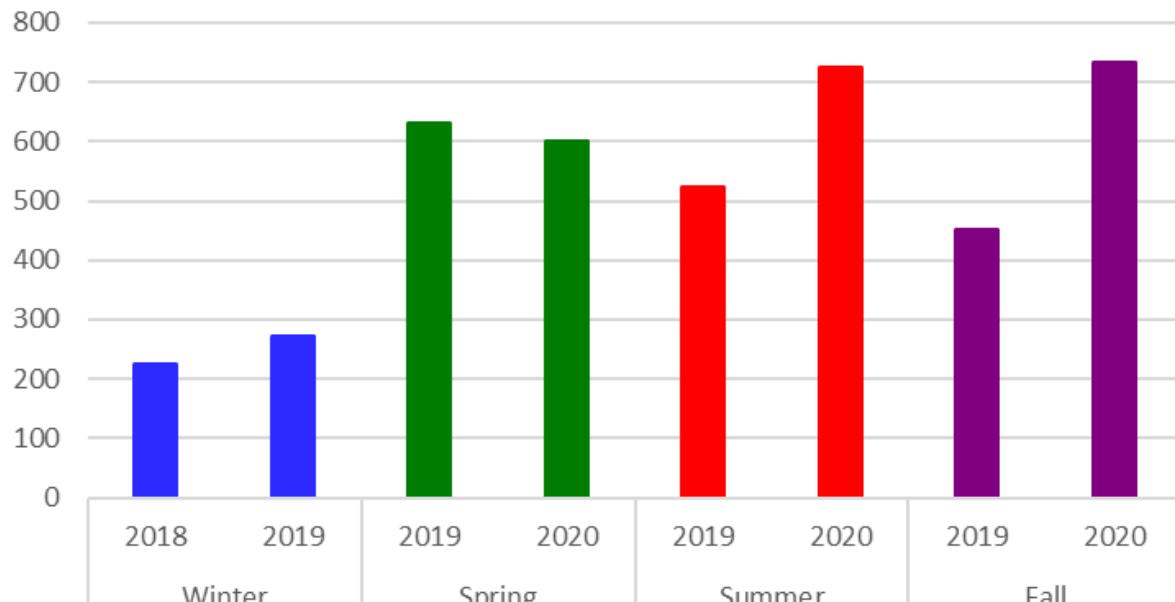
May  
June  
July

—●— Fall

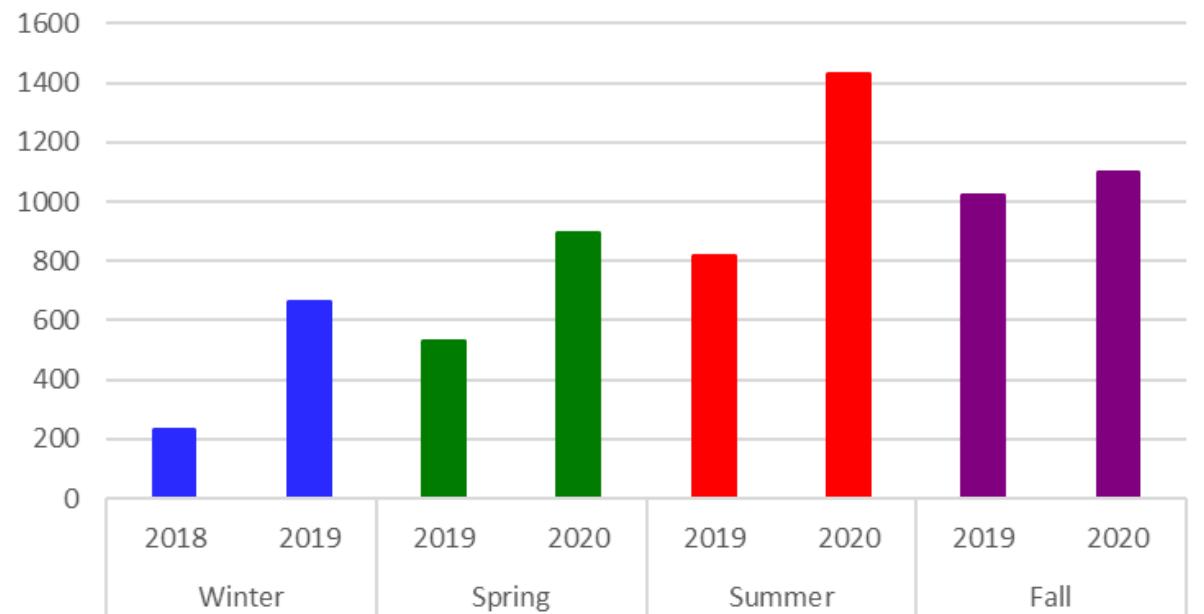
August  
September  
October

# Average Visitors by Season

Lakeshore Park Average Visitors by Season



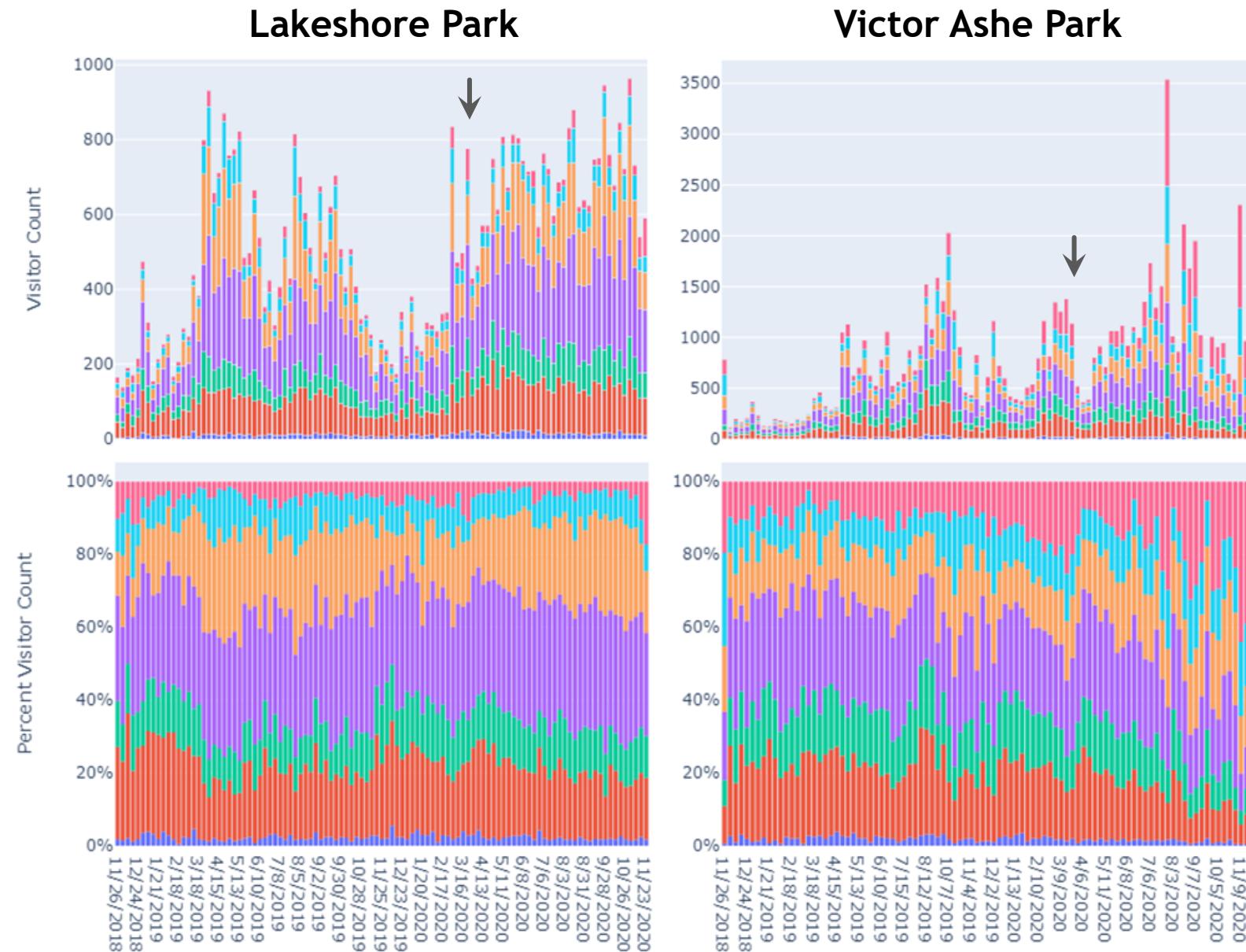
Victor Ashe Park Average Visitors by Season



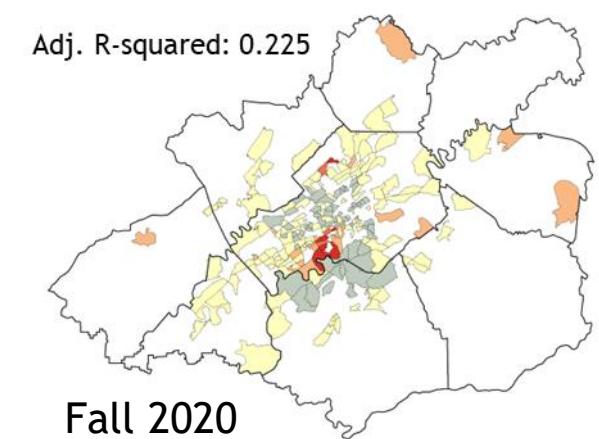
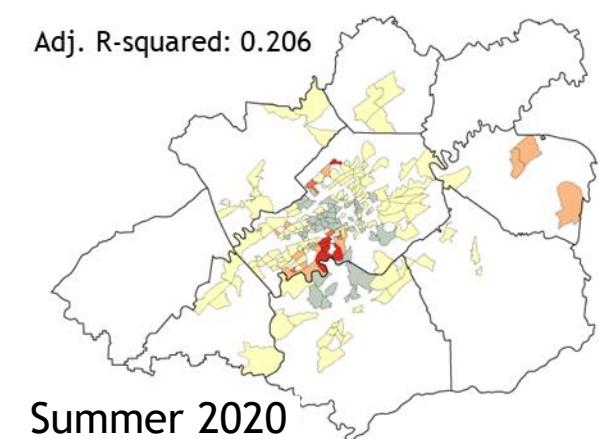
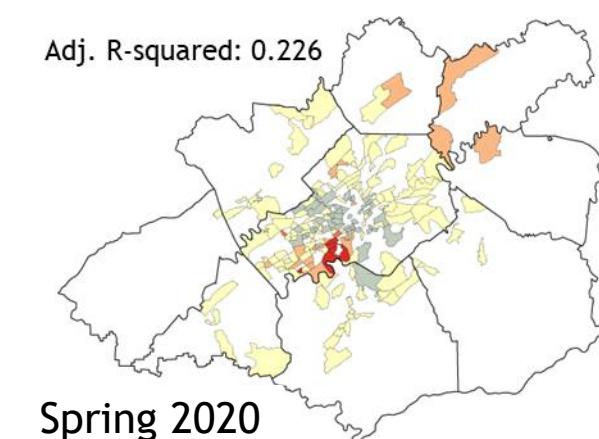
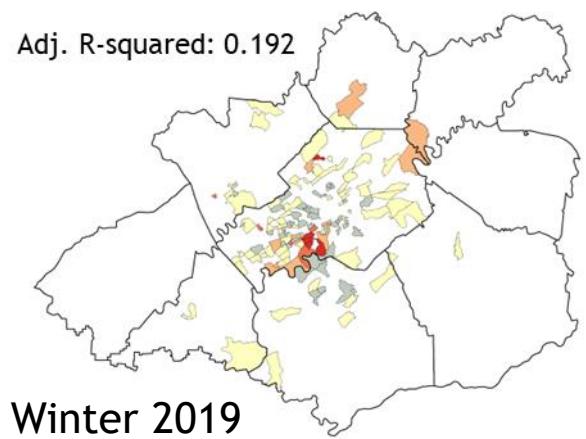
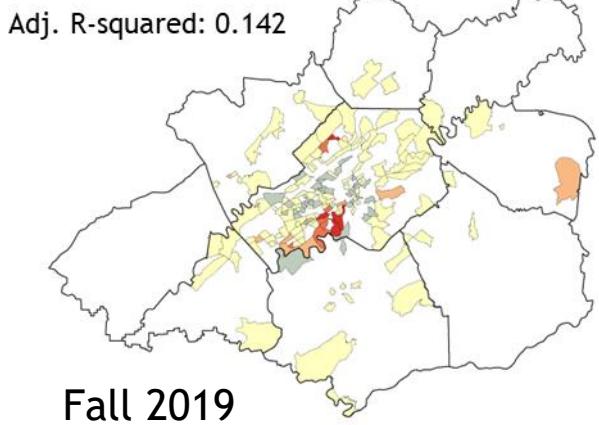
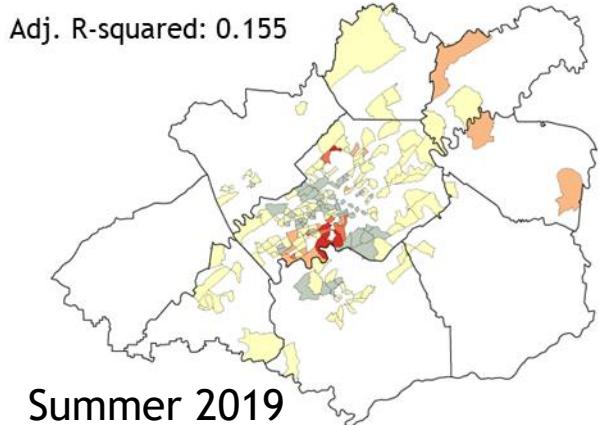
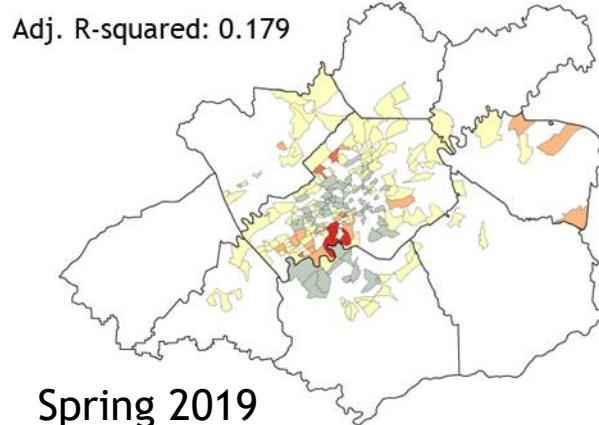
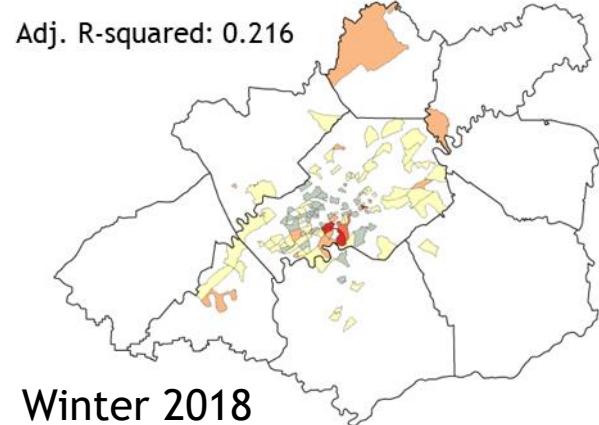
# Weekly Visitation Lengths in Minutes



- Arrows indicate when COVID-19 lockdowns were announced in Tennessee

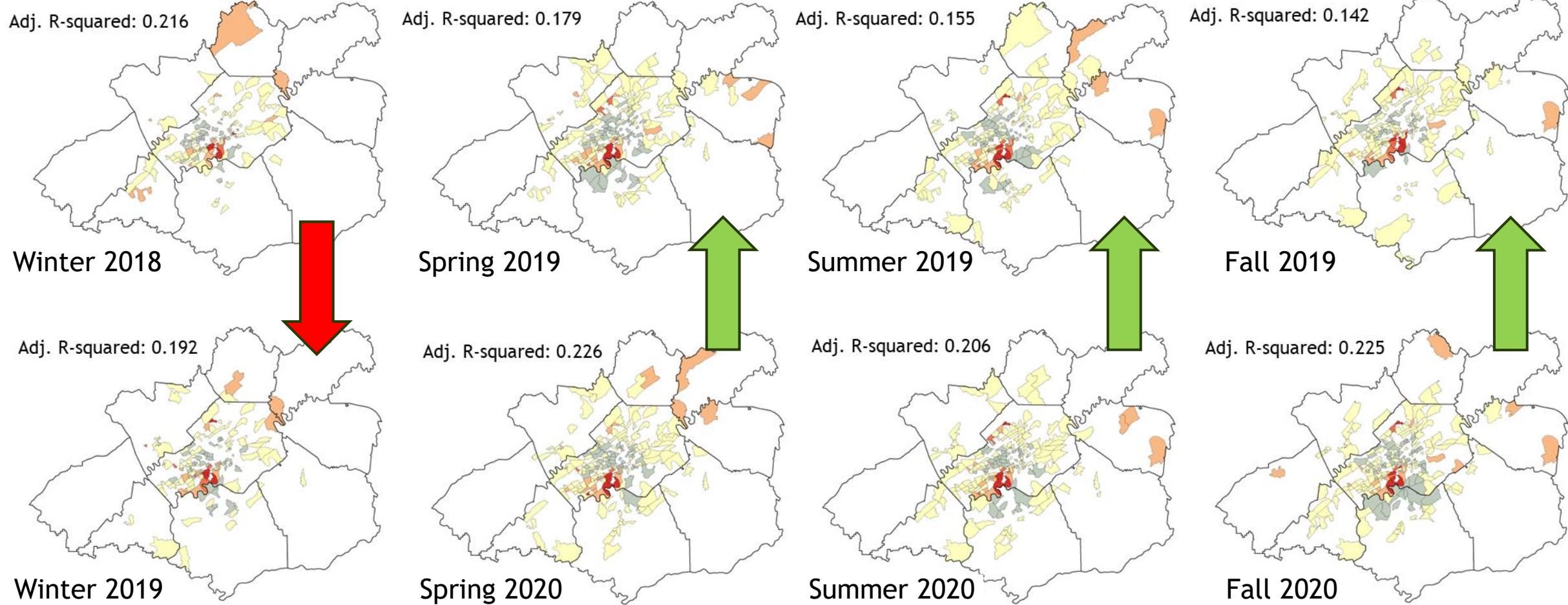


# Lakeshore Park OLS Regression



■ < -2.5 Std. Dev. ■ -2.5 - -1.5 Std. Dev. ■ -1.5 - -0.5 Std. Dev. ■ -0.5 - 0.5 Std. Dev. ■ 0.5 - 1.5 Std. Dev. ■ 1.5 - 2.5 Std. Dev. ■ > 2.5 Std. Dev.

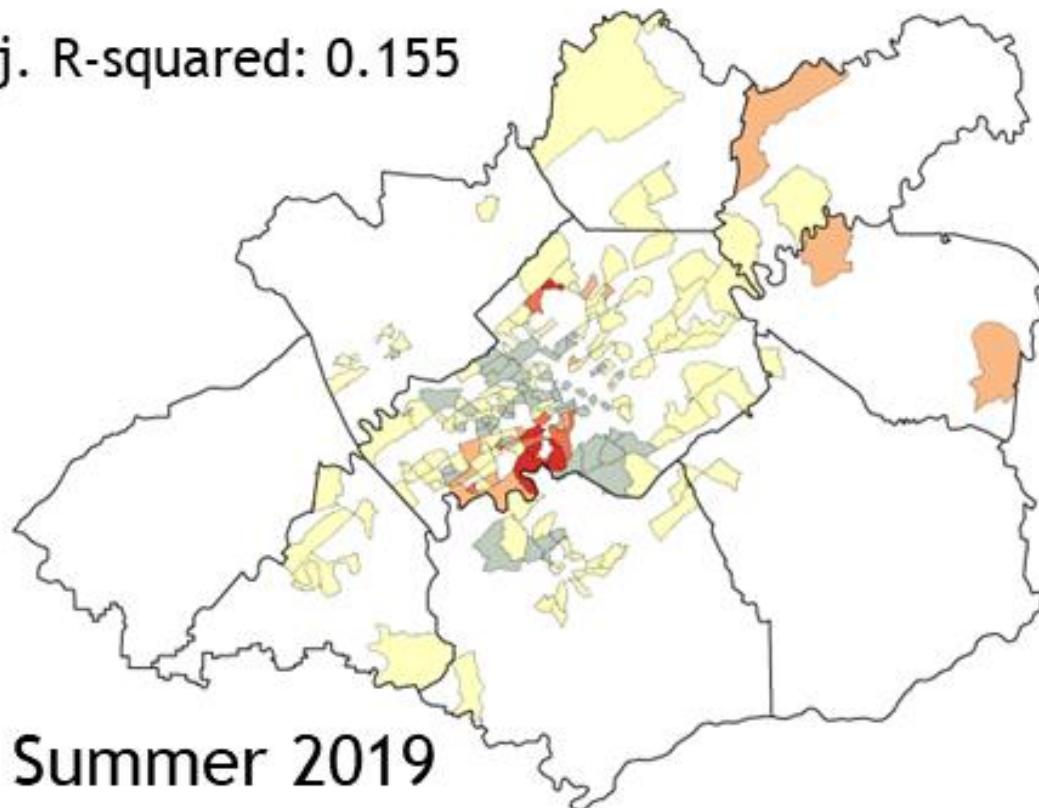
# Lakeshore Park OLS Regression



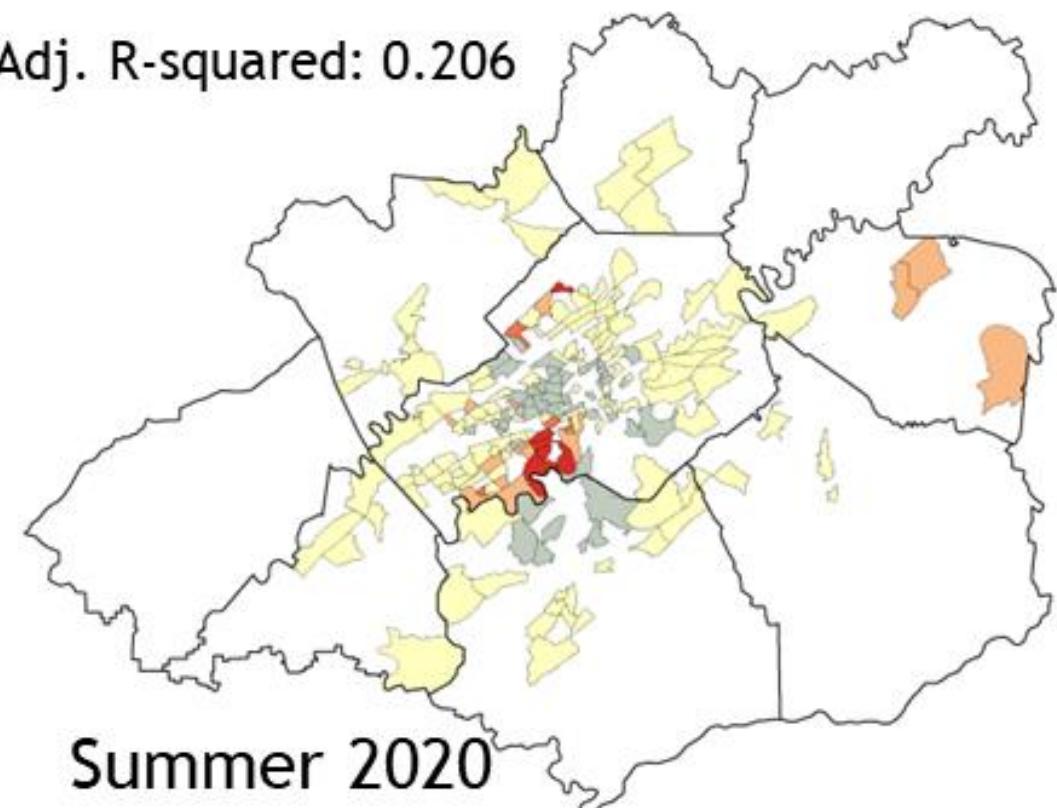
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# Lakeshore Park OLS Regression

Adj. R-squared: 0.155



Adj. R-squared: 0.206

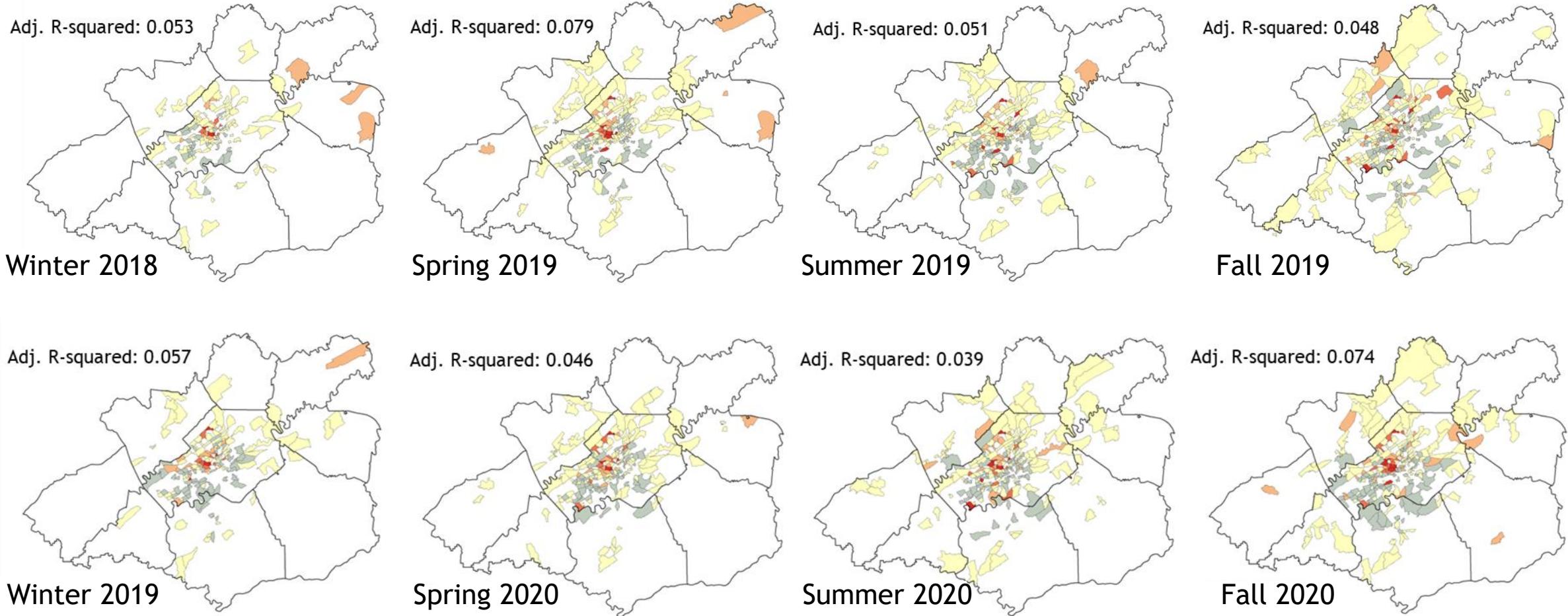


Summer 2019

Summer 2020

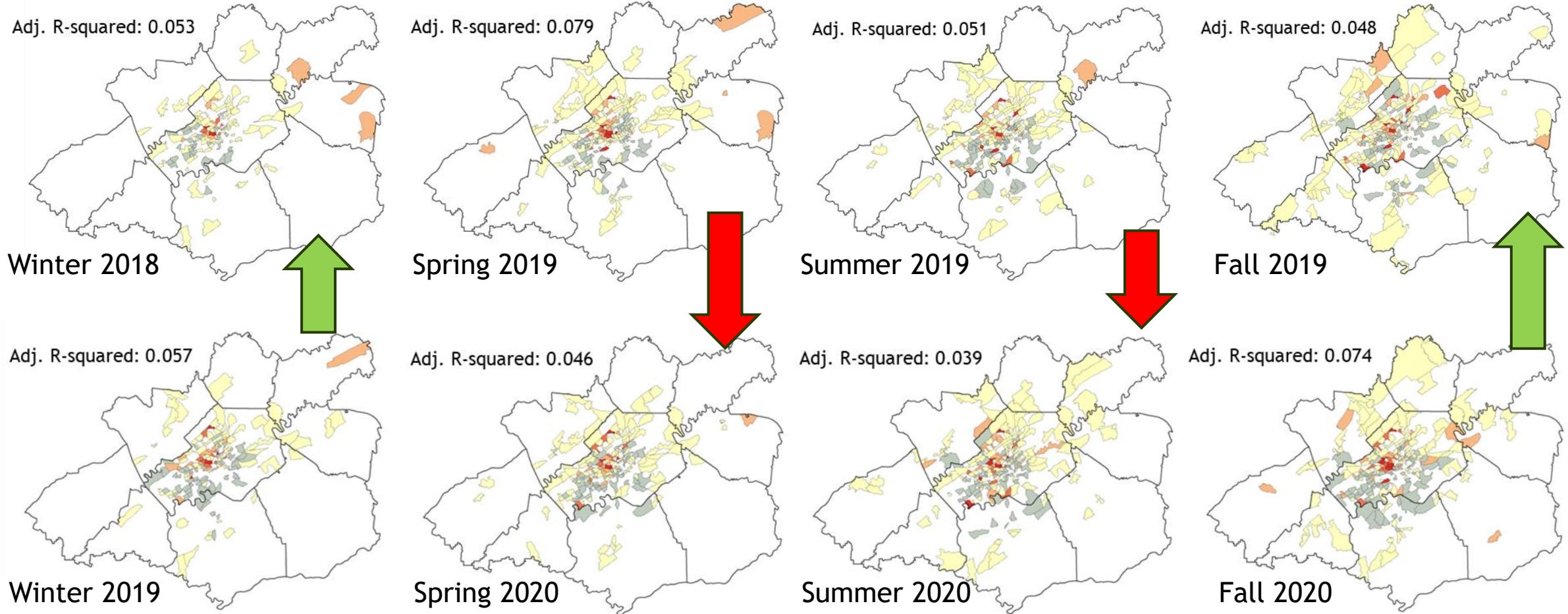
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# Victor Ashe Park OLS Regression



■ < -2.5 Std. Dev. ■ -2.5 - -1.5 Std. Dev. ■ -1.5 - -0.5 Std. Dev. ■ -0.5 - 0.5 Std. Dev. ■ 0.5 - 1.5 Std. Dev. ■ 1.5 - 2.5 Std. Dev. ■ > 2.5 Std. Dev.

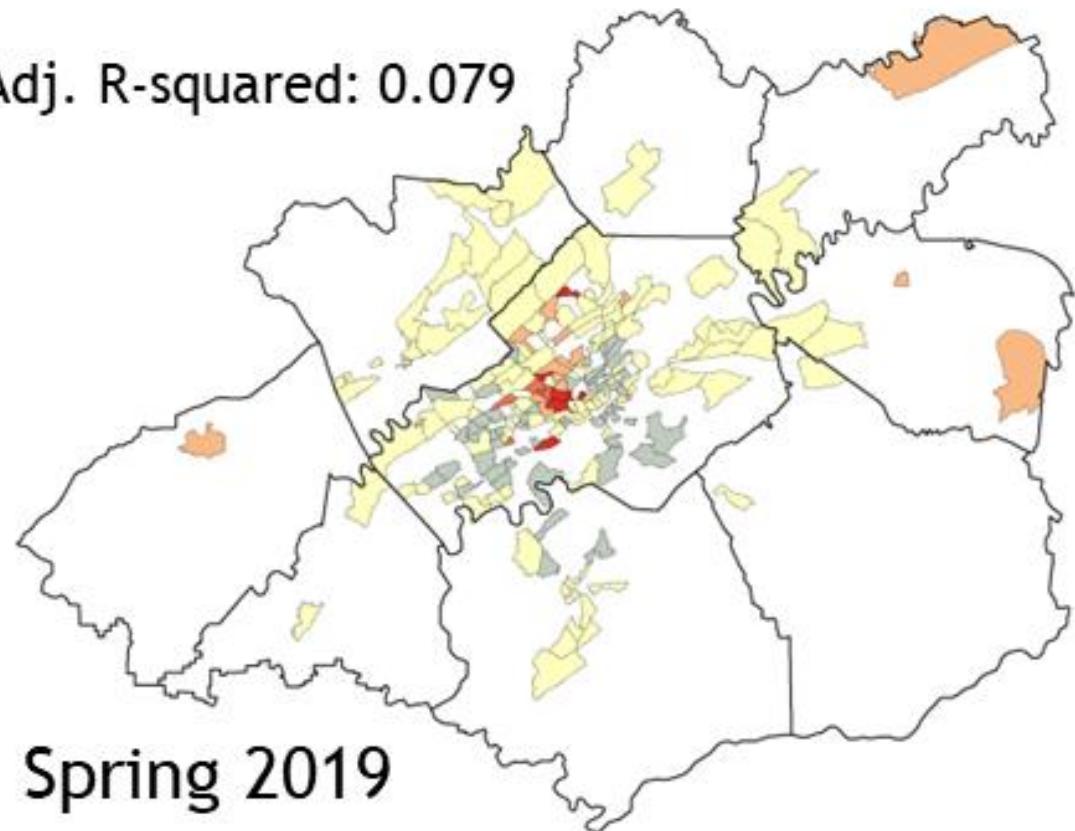
# Victor Ashe Park OLS Regression



■ < -2.5 Std. Dev. ■ -2.5 - -1.5 Std. Dev. ■ -1.5 - -0.5 Std. Dev. ■ -0.5 - 0.5 Std. Dev. ■ 0.5 - 1.5 Std. Dev. ■ 1.5 - 2.5 Std. Dev. ■ > 2.5 Std. Dev.

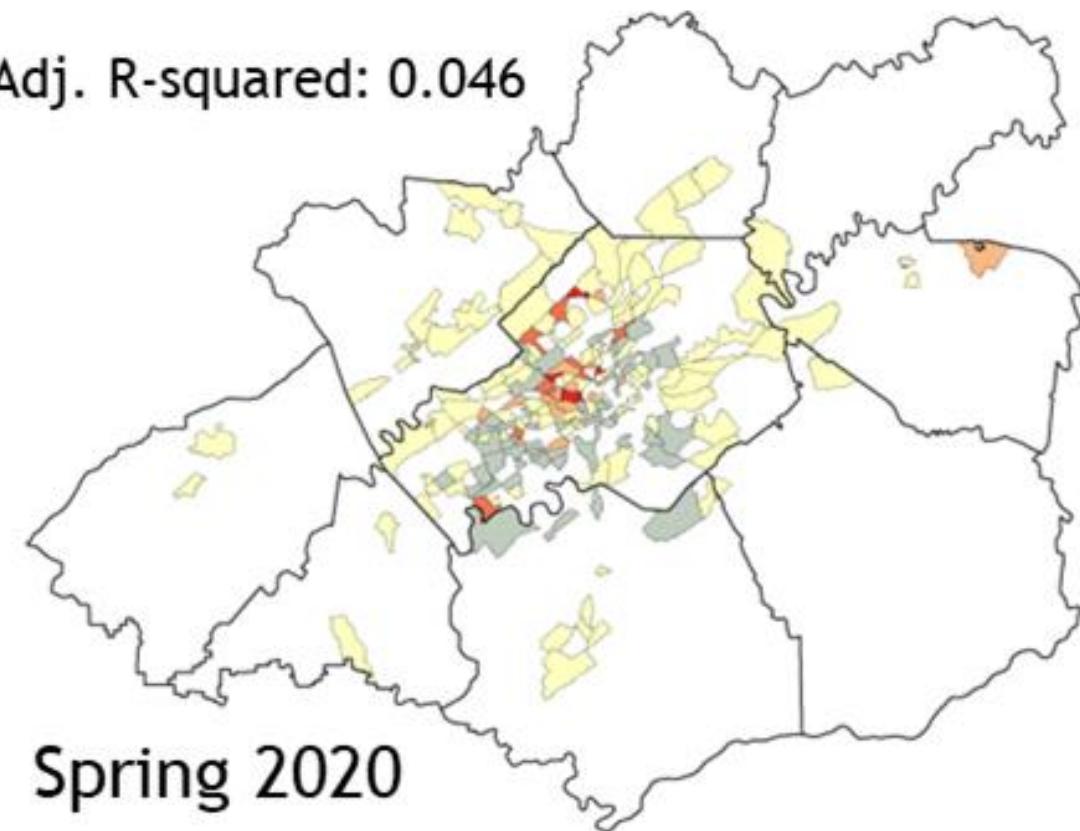
# Victor Ashe Park OLS Regression

Adj. R-squared: 0.079



Spring 2019

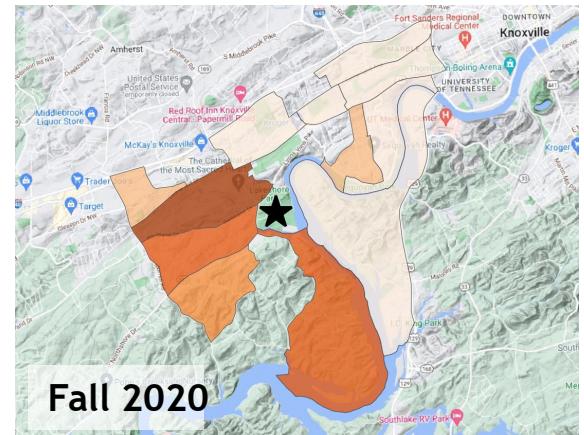
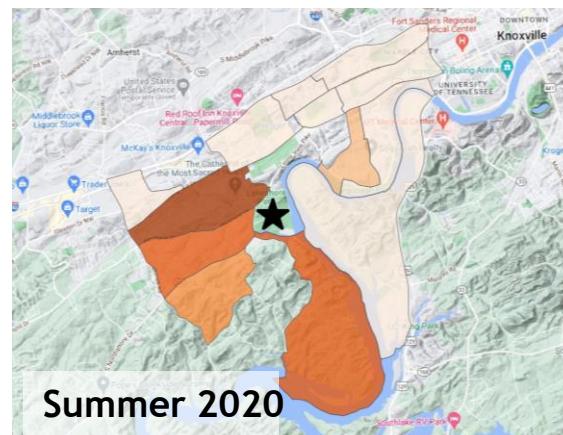
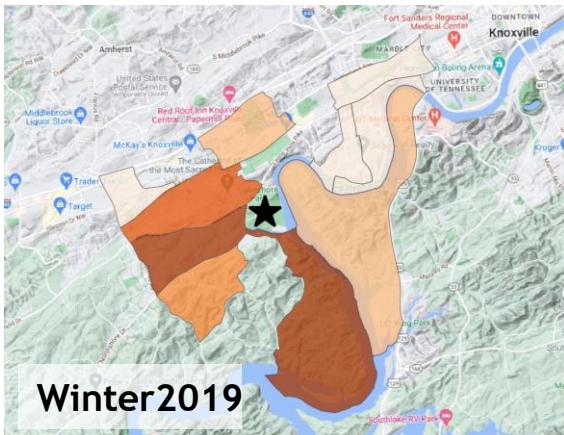
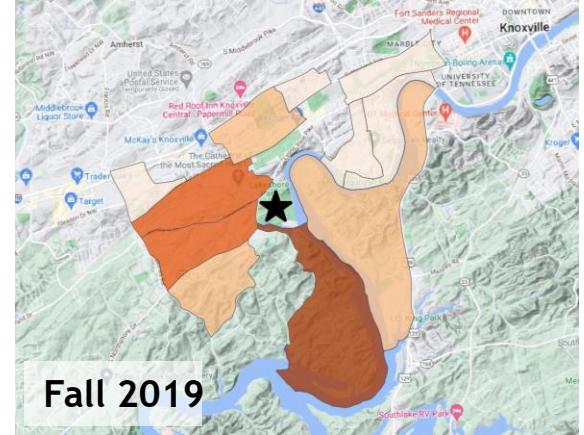
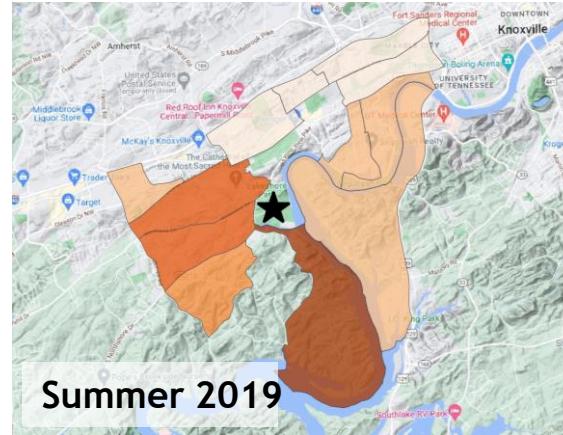
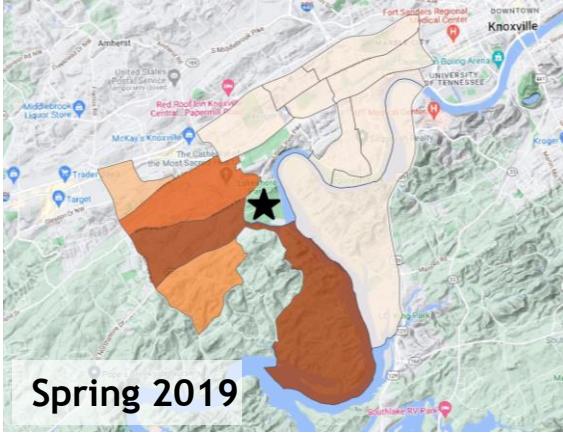
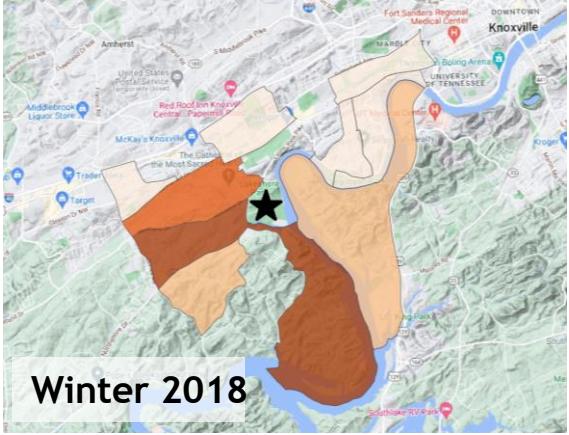
Adj. R-squared: 0.046



Spring 2020

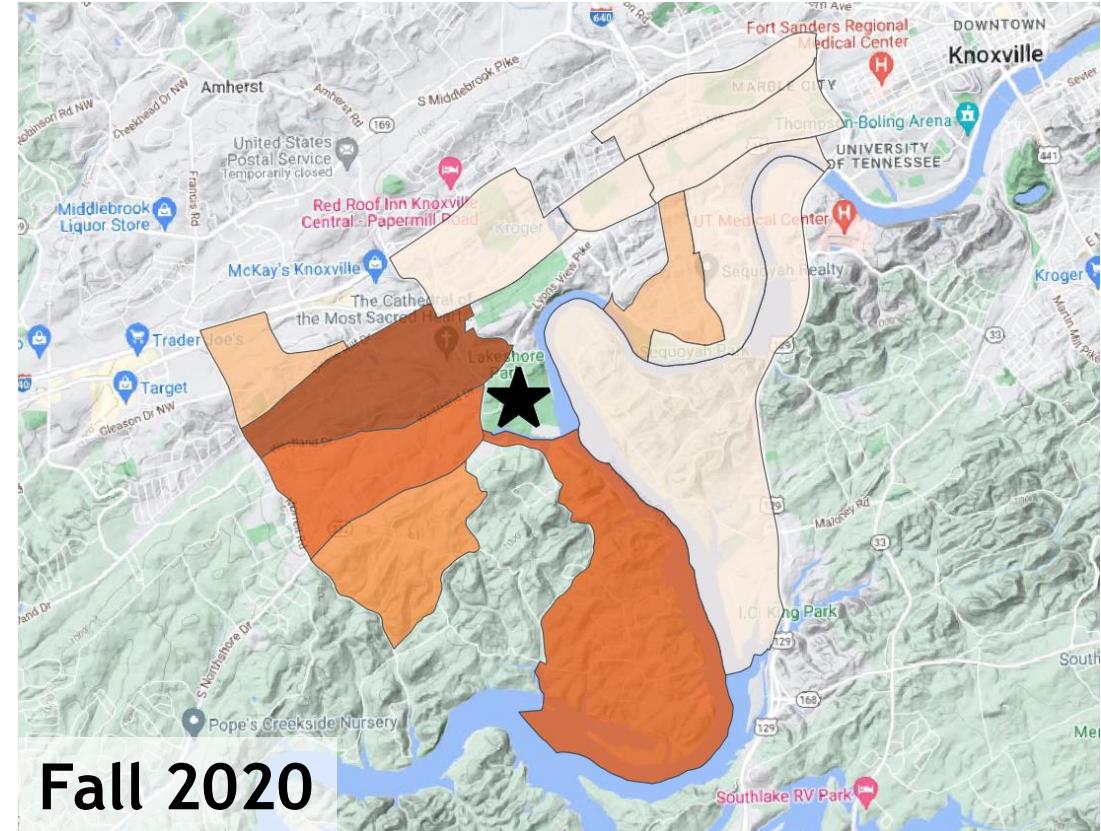
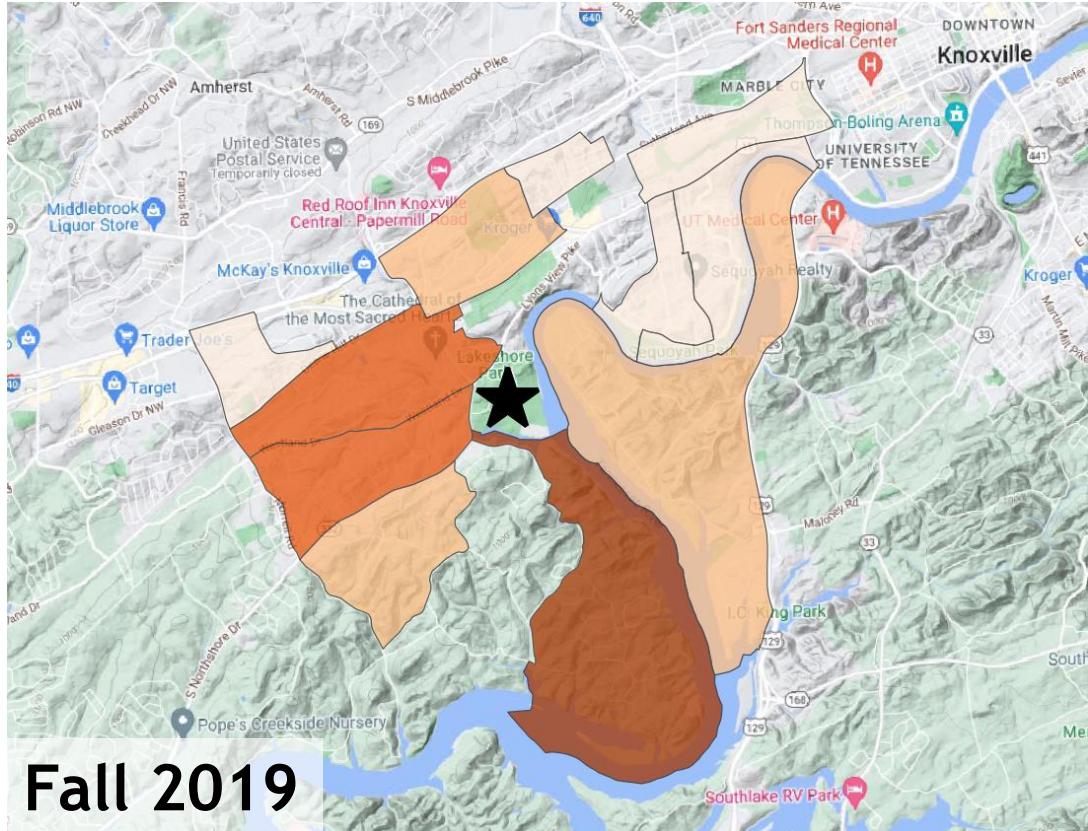
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# Percent of Visitors from Each Census Block Group Surrounding Lakeshore Park



□ < 5%    □ 5% to 10%    □ 10% to 15%    □ 15% to 20%    □ >20%

# Percent of Visitors from Each Census Block Group Surrounding Lakeshore Park



< 5%

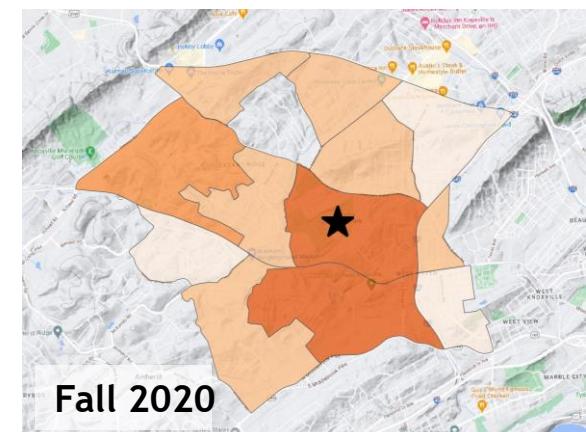
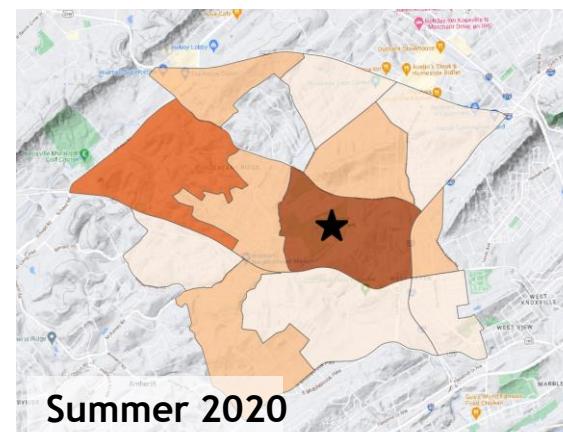
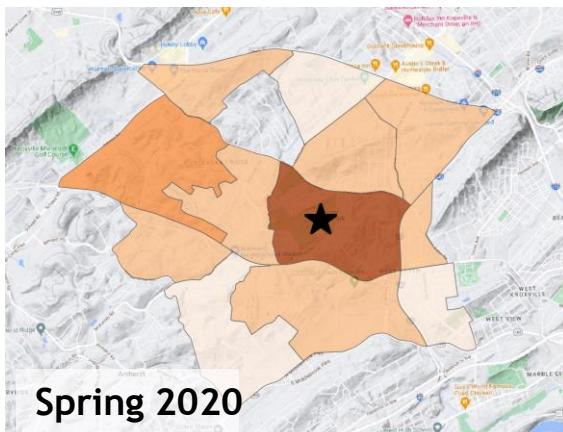
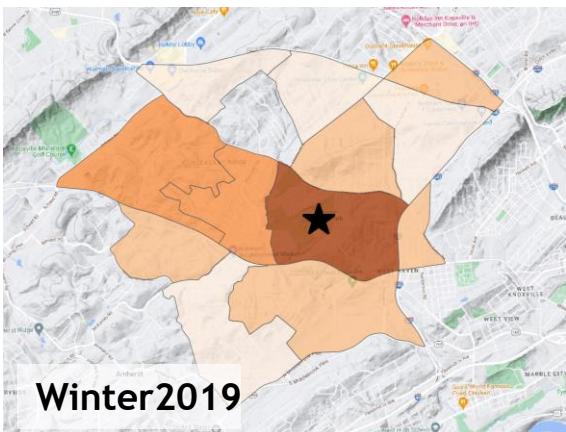
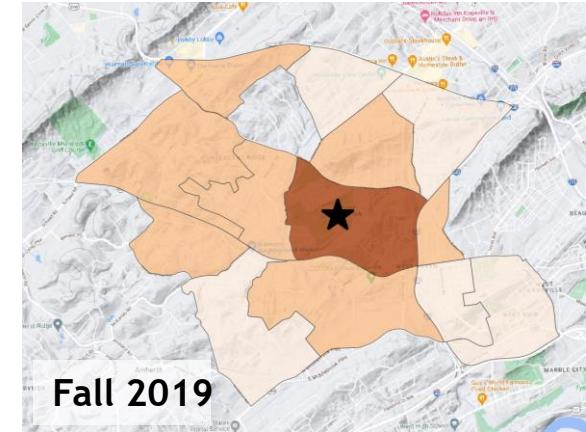
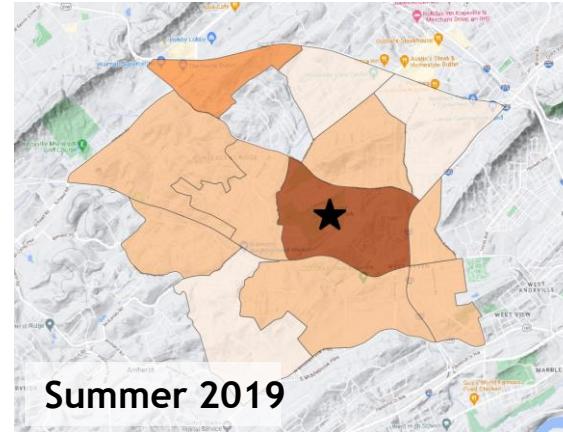
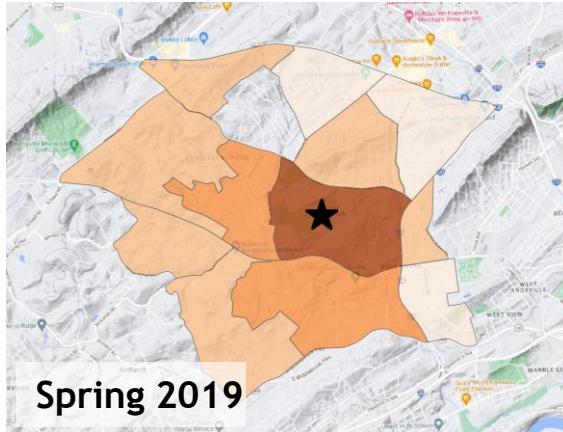
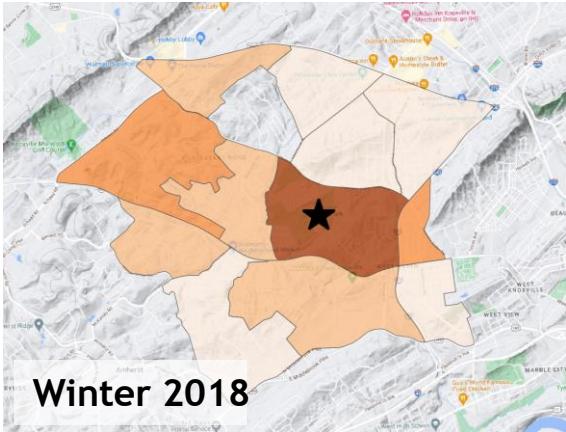
5% to 10%

10% to 15%

15% to 20%

> 20%

# Percent of Visitors from Each Census Block Group Surrounding Victor Ashe Park



< 5%

5% to 10%

10% to 15%

15% to 20%

> 20%

# Final Conclusions

- ▶ The distance that visitors were willing to travel was influenced by a rise of COVID-19 for Lakeshore Park
- ▶ There is not a clear relationship between distance and visitation rates for Victor Ashe Park
- ▶ This can be attributed to how people travel to the parks
  - ▶ This study largely relied on people traveling in a vehicle
  - ▶ To study pedestrian traffic, it may be better to look at the walkability around a park as well as the population within a certain distance zone

# Future Work

- ▶ Analyze other variables that influence park visitation rates such as:
  - ▶ Pedestrian infrastructure vs. vehicle infrastructure
  - ▶ Length of greenway and/or unpaved trails
  - ▶ Types of fields available (soccer, baseball, disc golf, etc.)
  - ▶ Number of pavilions or other outdoor structures for gatherings
  - ▶ Available amenities
- ▶ Additional analyses could provide insights into what makes a park successful in a local community