

IDENTIFYING VULNERABLE COMMUNITIES THROUGH ESSENTIAL SERVICE ACCESS

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Background

As Louisiana's coast disappears, its historic communities are disappearing too

New levees are too late to stop the exodus for bayou villages like Pointe-aux-Chenes.



Gerald Herbert / AP Photo



Jake Bittle
Staff Writer

Published

Feb 22, 2023

This story is excerpted from The Great Displacement: Climate Change and the Next American Migration, published by Simon & Schuster.

Background

LOUISIANA

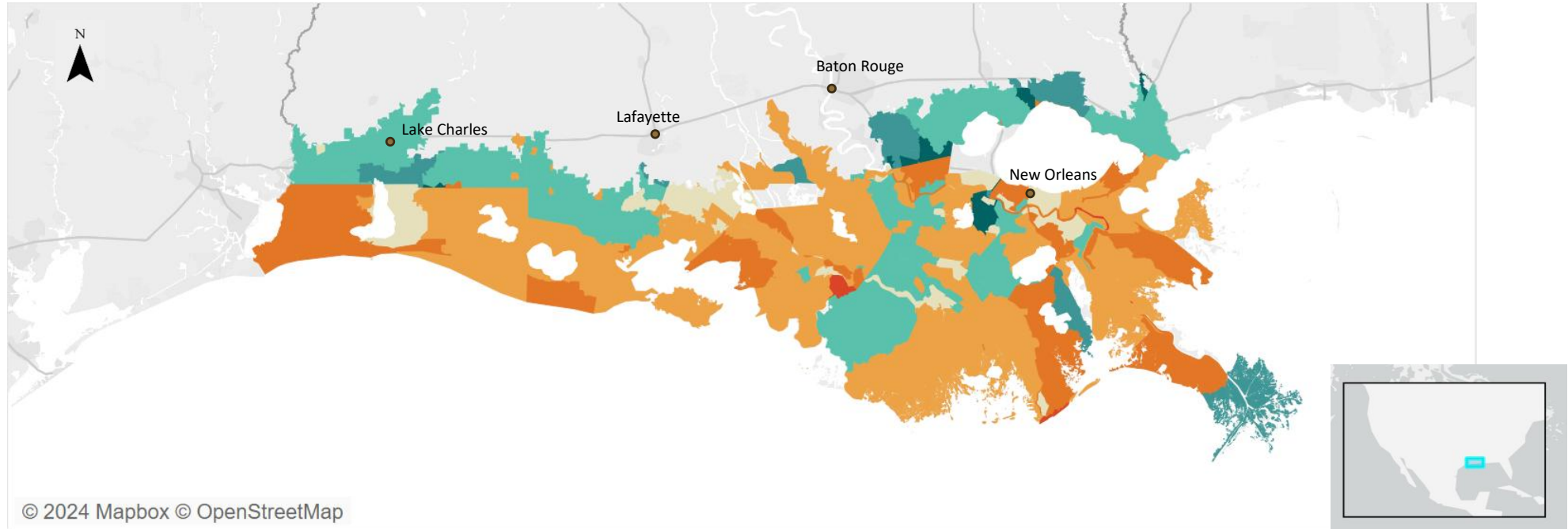
Louisiana's parishes ranked top 10 in the U.S. with largest percentage of population loss

Jakori Madison Lafayette Daily Advertiser

Published 2:45 p.m. CT May 2, 2023



Population Change in Louisiana



Percent Population Change 2000-2020

100% loss

50 to 100% loss

5 to 50% loss

5% loss to 5% gain

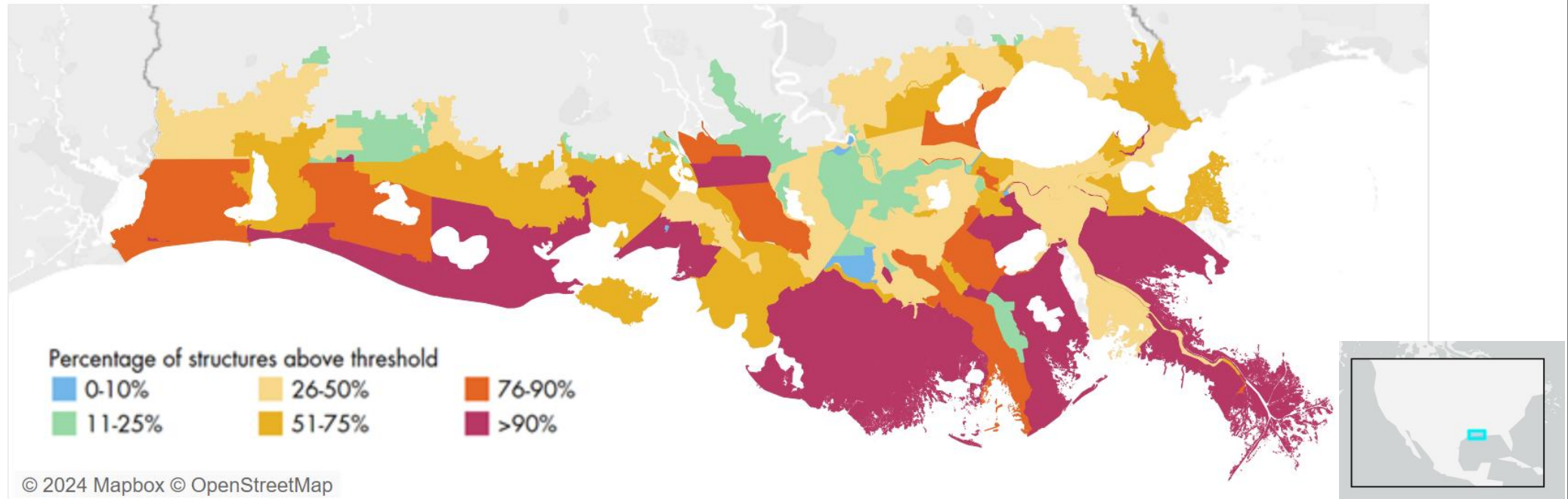
5 to 50% gain

50 to 100% gain

More than 100% gain

Asset Flood Exposure Risk in Louisiana

Percent of Commercial Structures with at least 50% likelihood over 30 years of being In Flooded Area



Background

SCIENCE

Louisiana is approaching a 'major failure' of its healthcare system as hospitals get dangerously close to capacity

Aria Bendix Aug 17, 2021, 3:33 PM PDT

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Louisiana's rural hospitals find ways to persevere in a multiple-front battle

By STEPHEN MARCANTEL | Staff writer Dec 2, 2024 4 min to read

STMaryNow.com

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Thu, 07/13/2023 - 12:41pm

STAFF REPORT



School of Industrial Engineering

10/20/2026

6

Background



Image Source: (Bittle, 2023)

45°

KLFY.com 10
ACADIANA'S LOCAL NEWS LEADER



LAFAYETTE PARISH

‘Lives are going to be affected’: Duson mayor reacts to possible school closure

by: [Kye Price](#)

Posted: Nov 14, 2024 / 08:15 PM CST

Updated: Nov 14, 2024 / 07:03 PM CST

Background

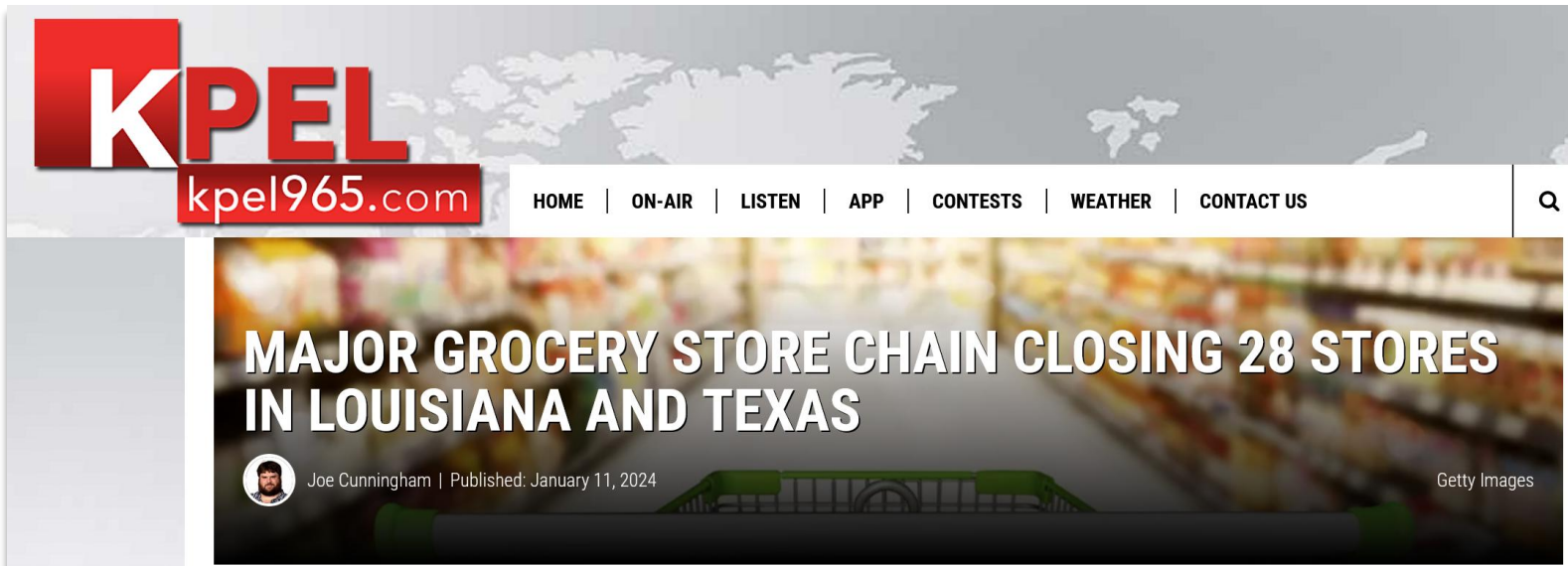


Image Source: (Herbert, 2020)

Empirical Setting

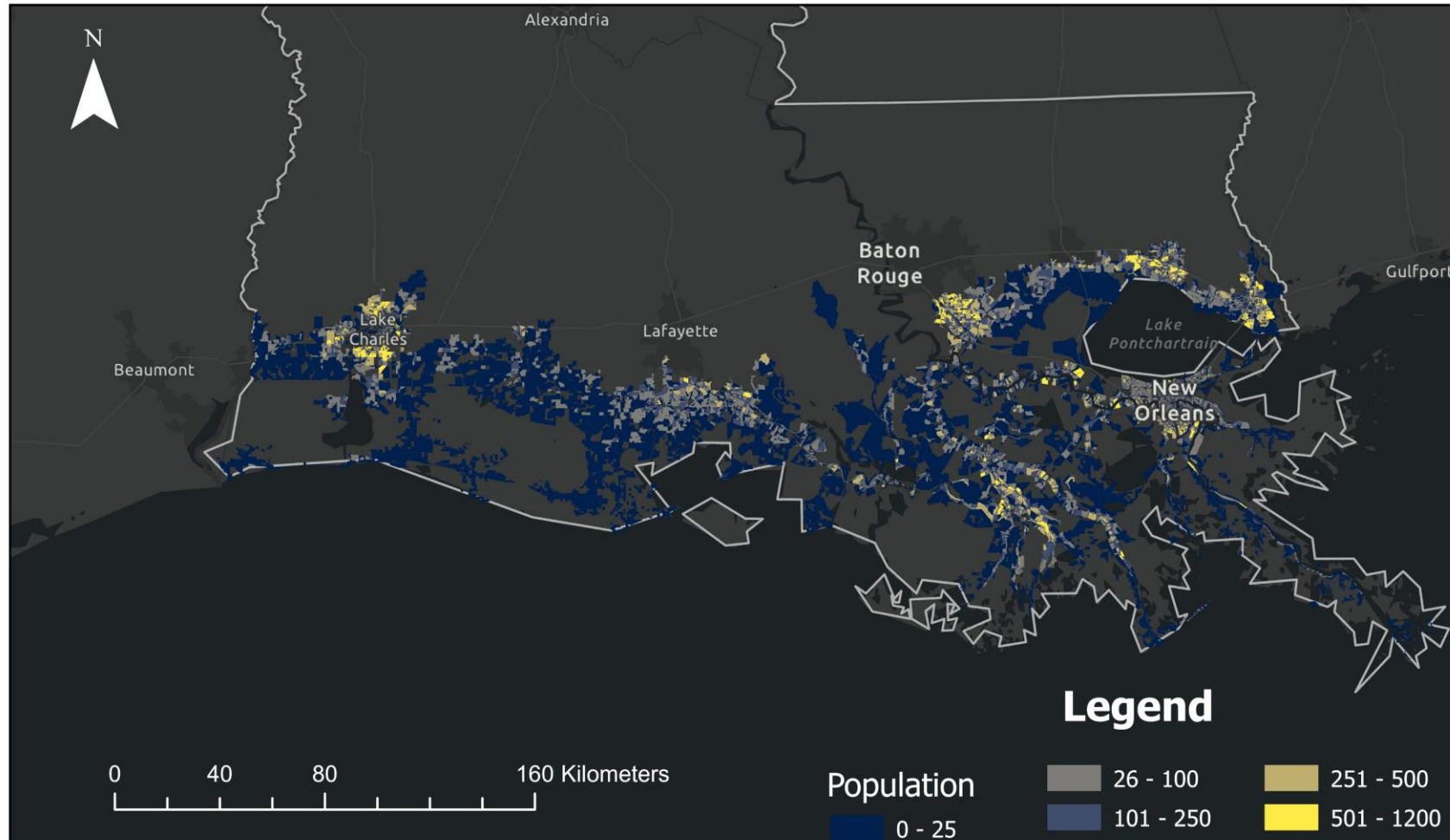
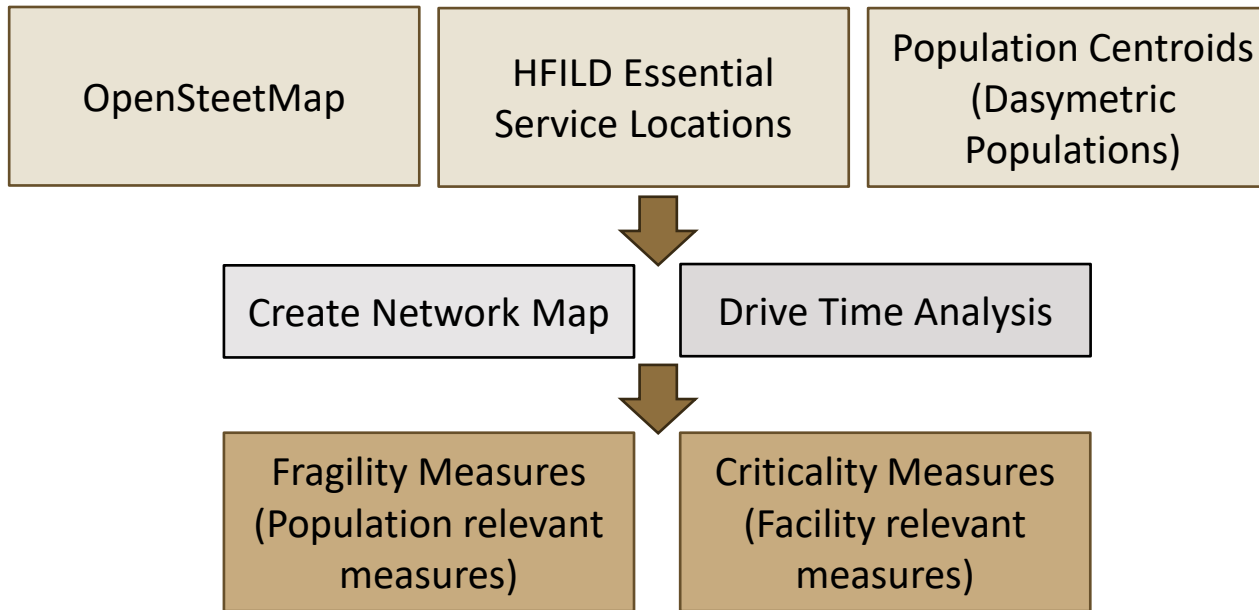


Figure 1. Empirical Setting Communities in Louisiana - Communities with population in Coastal Louisiana Risk Assessment (CLARA)

Research Questions

1. *How to quantify the fragility of the access to essential services using transportation networks as it relates to resilience?*
2. *How can we evaluate the critical importance of an essential service facility using drive-time analysis?*
3. *How will decision-makers' preferences regarding a criticality measure affect which facility is prioritized for protection?*

Methods: Overall Framework



- Drive time to closest location
- Marginal drive time between first and second closest location
- Number of alternative locations within critical time threshold

- Total population served as primary provider
- Primary population percentage with no other alternative under critical time threshold
- Weighted average of marginal travel time for primary population with no other alternative under critical time threshold

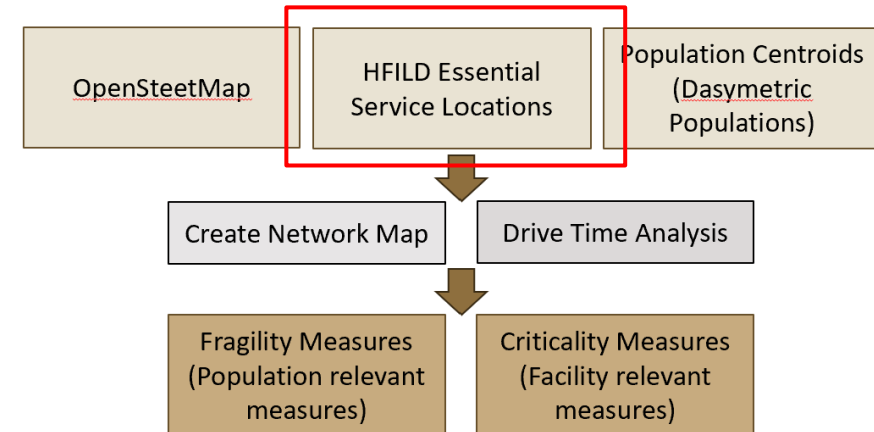
Policy Recommendations

Methods: Fragility

How to quantify the fragility of the access to essential services using transportation networks as it relates to resilience?

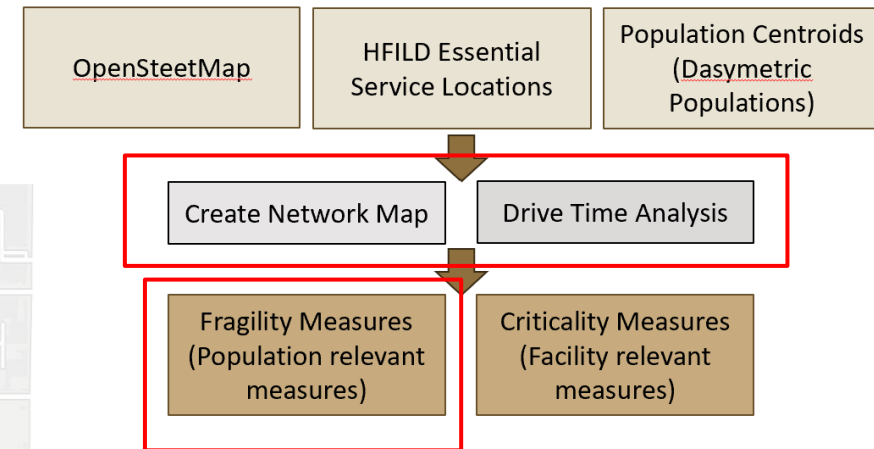
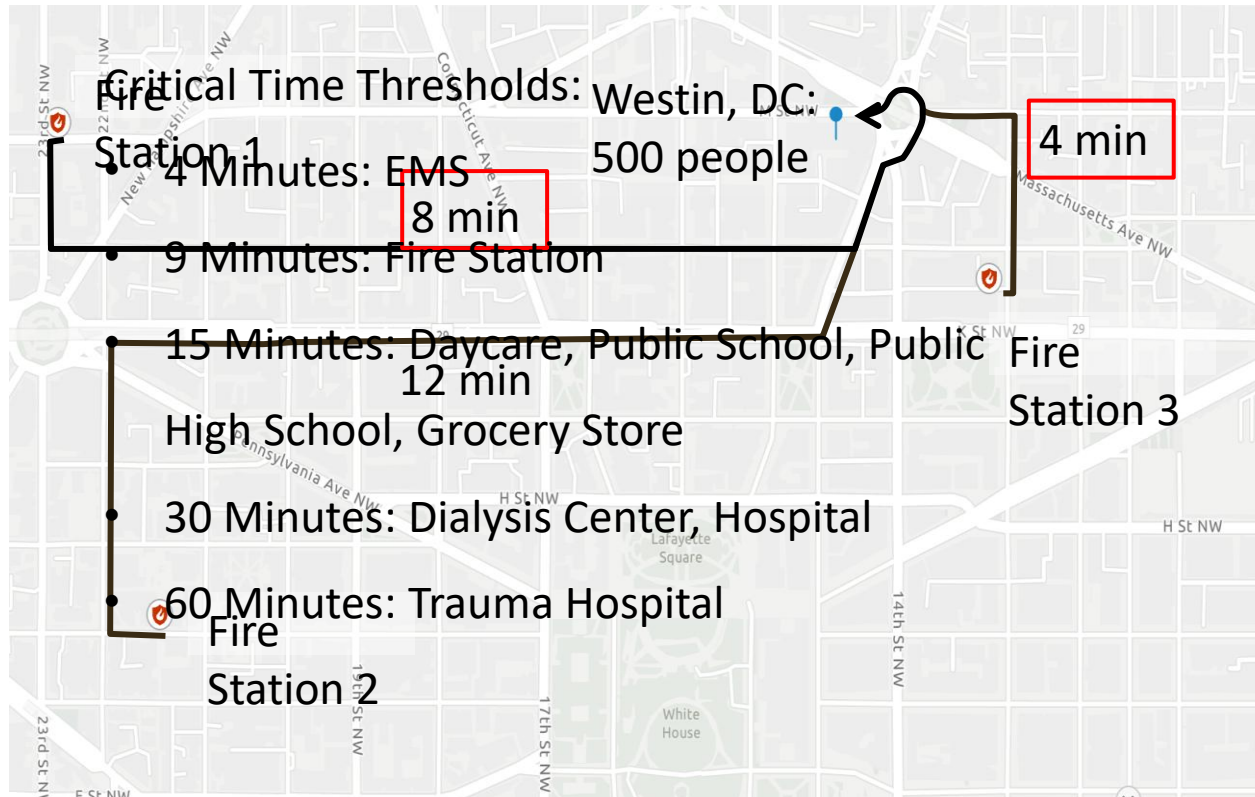
■ Essential Services:

- Emergency Medical Service (EMS)
- Fire Station
- Daycare
- Public School (Kindergarten, Elementary, Middle, Junior High)
- Public School (High School)
- Dialysis Center
- Hospital
- Trauma Hospital
- Grocery Store



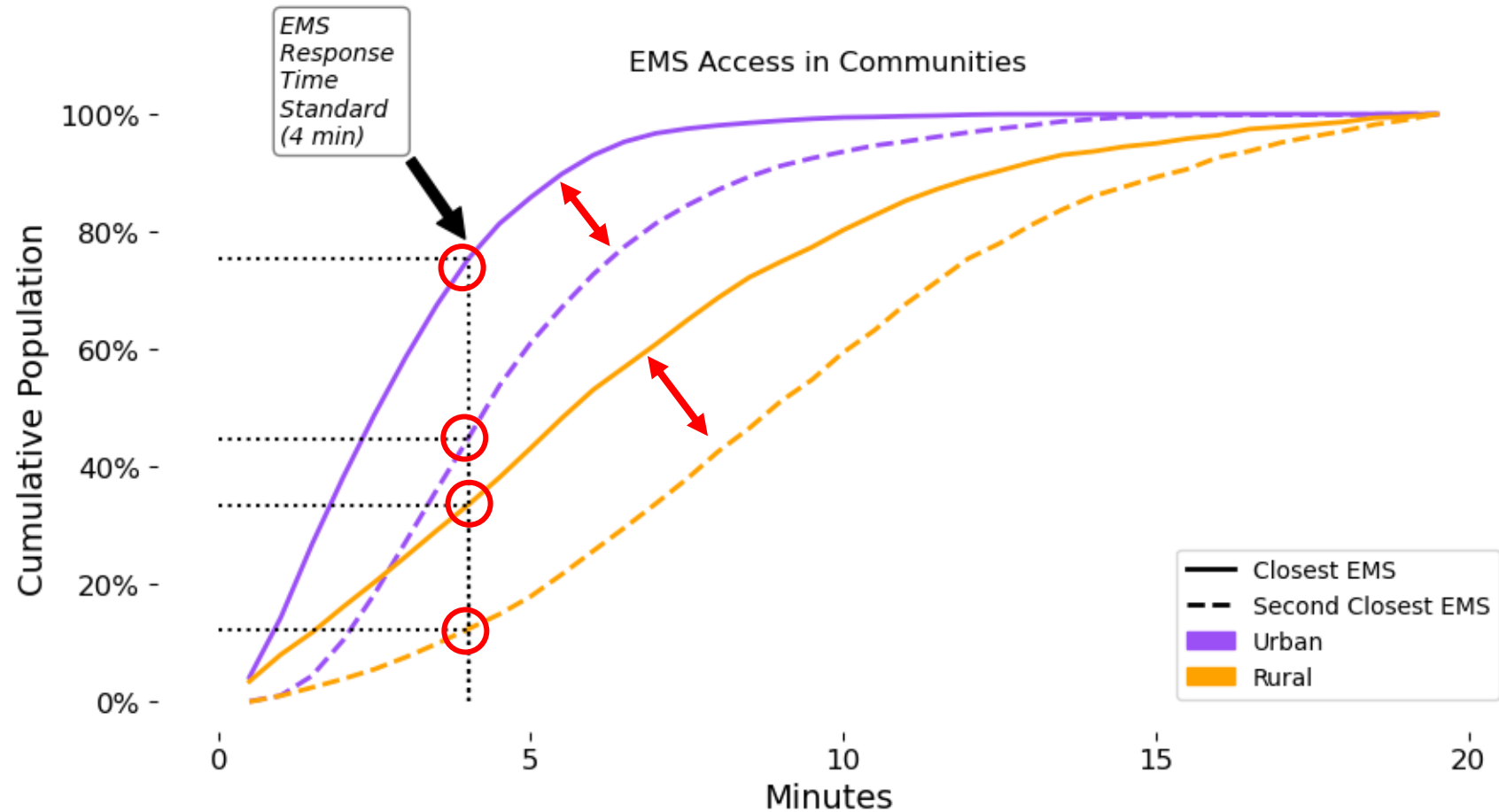
Methods: Fragility

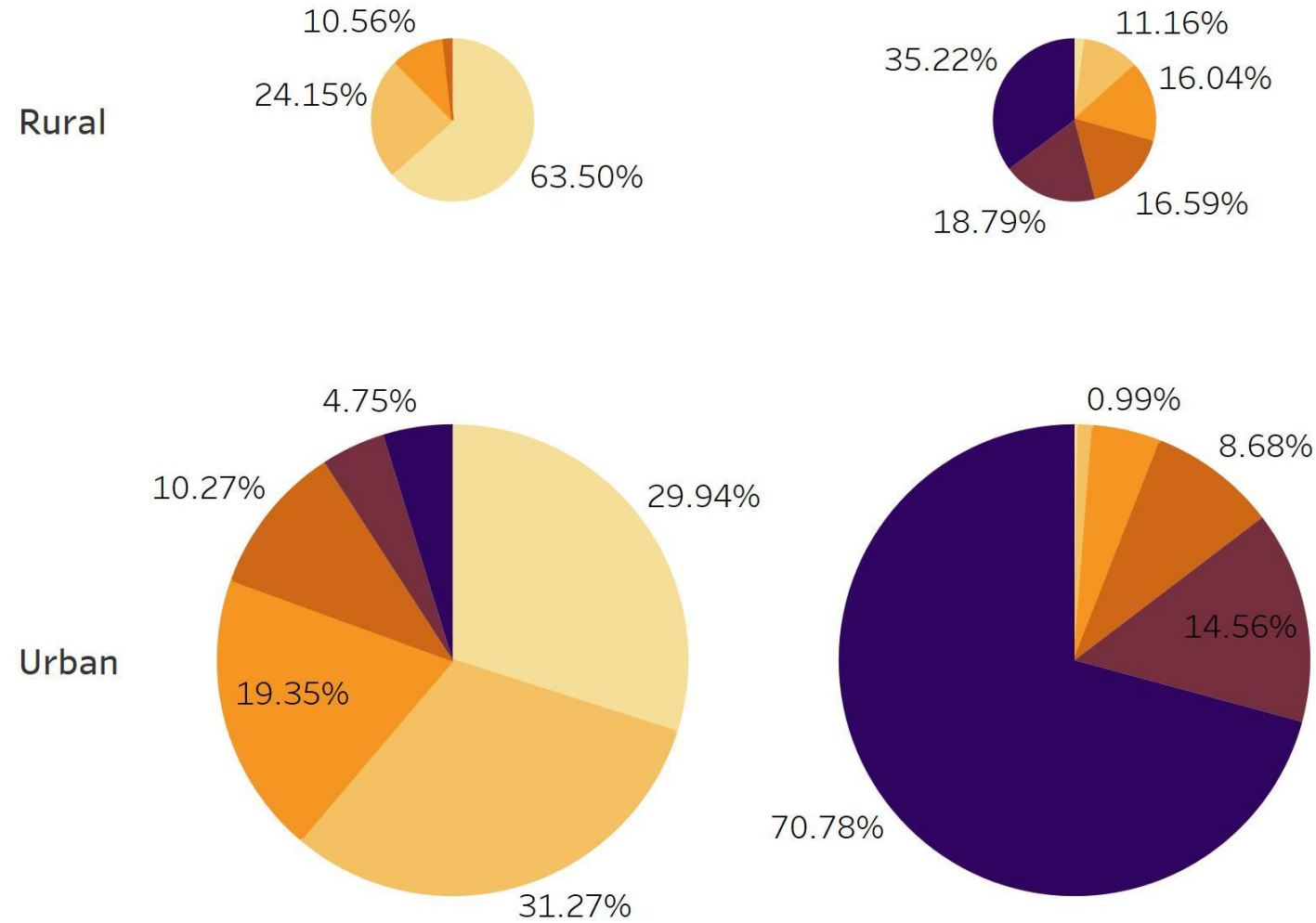
How to quantify the fragility of the access to essential services using transportation networks as it relates to resilience?



- Drive time to closest location
- Marginal drive time between first and second closest location
- Number of alternative locations within critical time threshold

Urban – Rural Differences in Fragility: EMS





Number of Alternatives

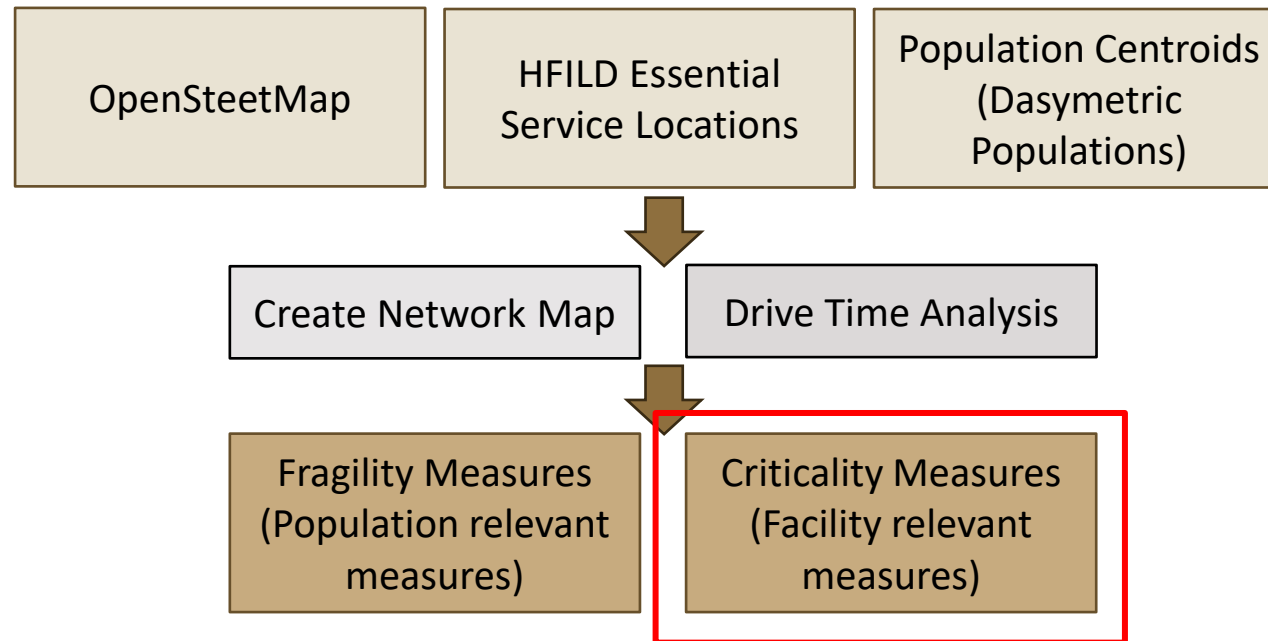


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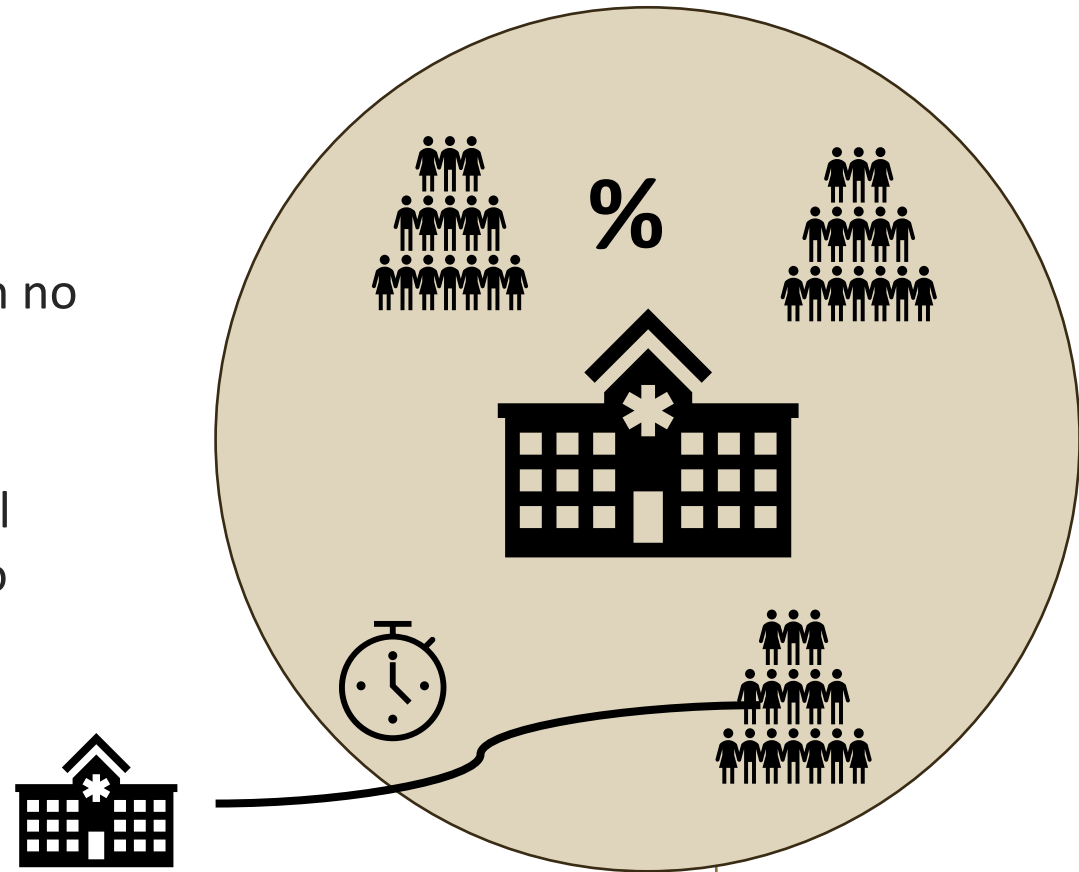
Methods: Overall Framework



Methods: Criticality

How can we evaluate the critical importance of an essential service facility using drive-time analysis?

- Total population served as primary provider
- Primary population percentage with no other alternative under critical time threshold
- Weighted average of marginal travel time for primary population with no other alternative under critical time threshold



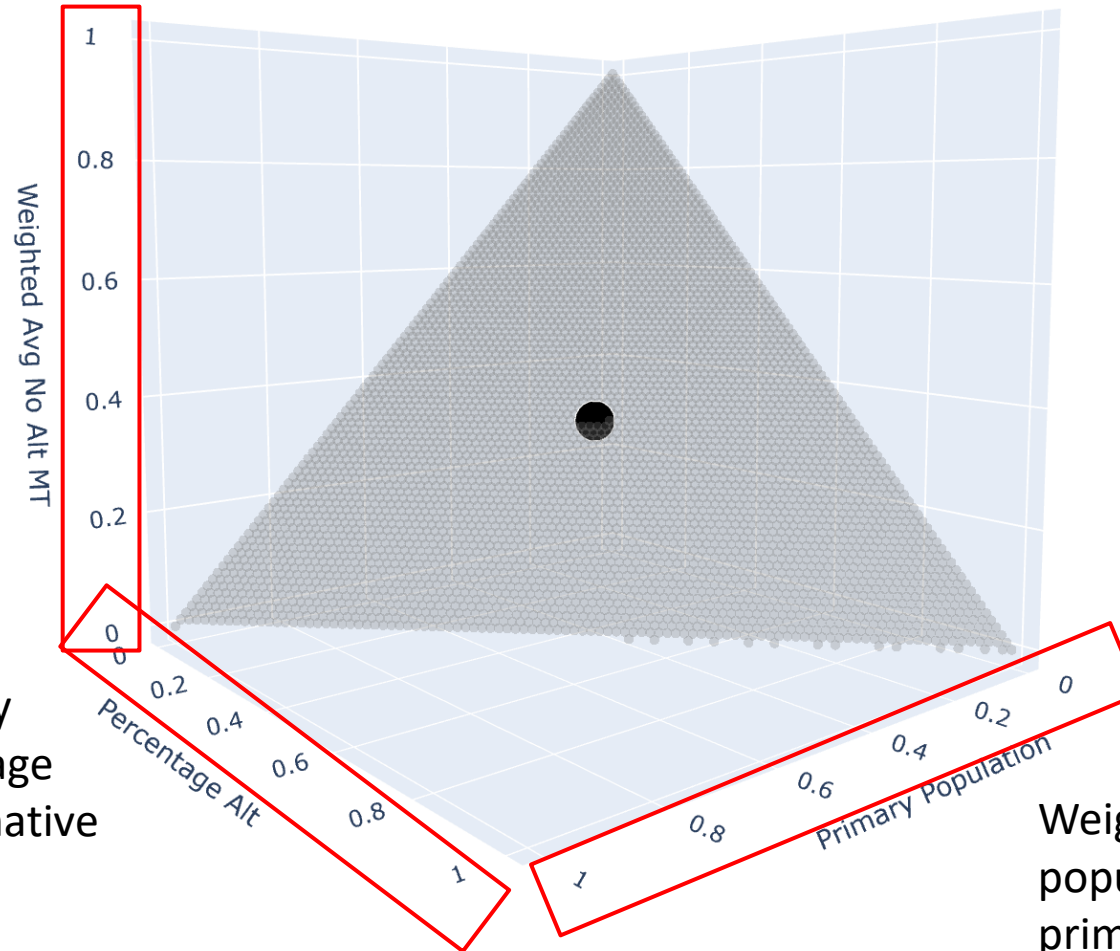
Criticality

- Normalize all three measures
- Create a large combination space of weights
- $Criticality = w_1 * P + w_2 * A + w_3 * M$
- w_1, w_2, w_3 : Weights assigned to each variable, which must sum to 1 ($w_1 + w_2 + w_3 = 1$)
- P : Primary population served by the facility
- A : Primary population percentage without an alternative
- M : Weighted average of marginal travel time for primary population with no other alternative under critical time threshold
- Rank all facilities within their type between 1-5 based on their criticality score (higher = more critical)
 - We care about rank stability of facilities in determining criticality → facilities that constantly appear in top 5 are critical

Weight Space

Weights for: weighted average of marginal travel time for primary population with no other alternative under critical time threshold

Weights for: Primary population percentage with no other alternative under critical time threshold



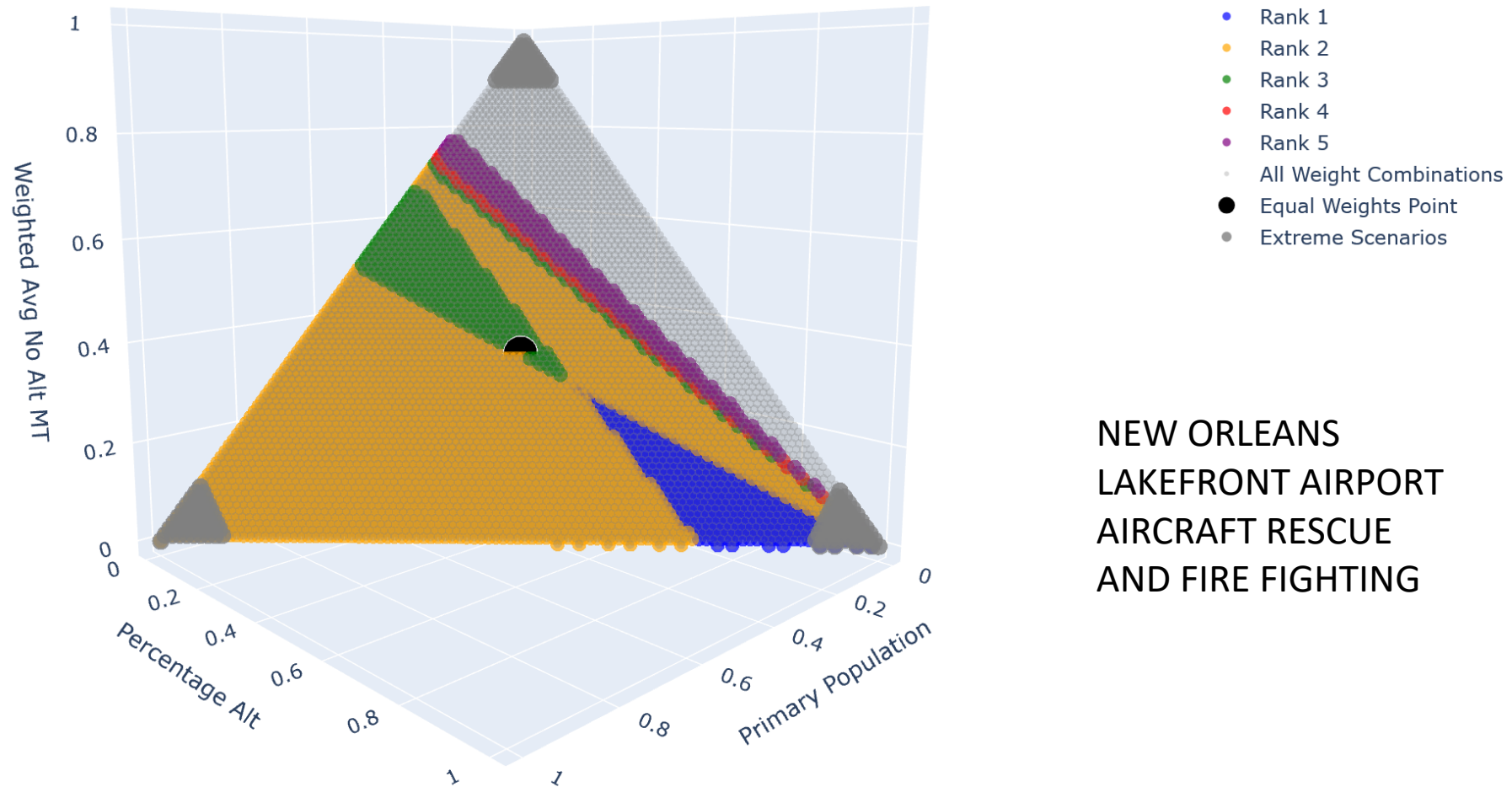
Weights for: total population served as primary provider

Criticality – Most Critical EMS Facilities

	Row Rank	Facility Name	Primary Population	Percentage without Alternative	Weighted Avg Marginal Time (No Alt)	Rank 1%	Rank 2%	Rank 3%	Rank 4%	Rank 5%	Total Percentage	Equal Weight Rank
Urban	1	NEW ORLEANS LAKEFRONT AIRPORT AIRCRAFT RESCUE ...	103195	100.00	5.53	6.67	55.88	8.56	1.83	3.79	76.72	3.0
Rural	2	PLAQUEMINES PARISH AMBULANCE DEPARTMENT - WOOD...	374	100.00	32.39	50.28	2.17	4.89	13.05	4.47	74.87	2.0
Urban	3	NEW ORLEANS EMERGENCY MEDICAL SERVICES	125109	94.19	2.67	43.03	11.20	10.53	1.35	1.37	67.48	1.0
Urban	4	EASTBANK CONSOLIDATED FIRE DEPARTMENT STATION 17	92471	97.70	3.17	0.00	0.58	42.81	18.02	1.03	62.44	4.0
Rural	5	CAMERON PARISH EMERGENCY MEDICAL SERVICES - GR...	312	100.00	16.50	0.00	30.10	4.21	4.55	13.11	51.97	NaN

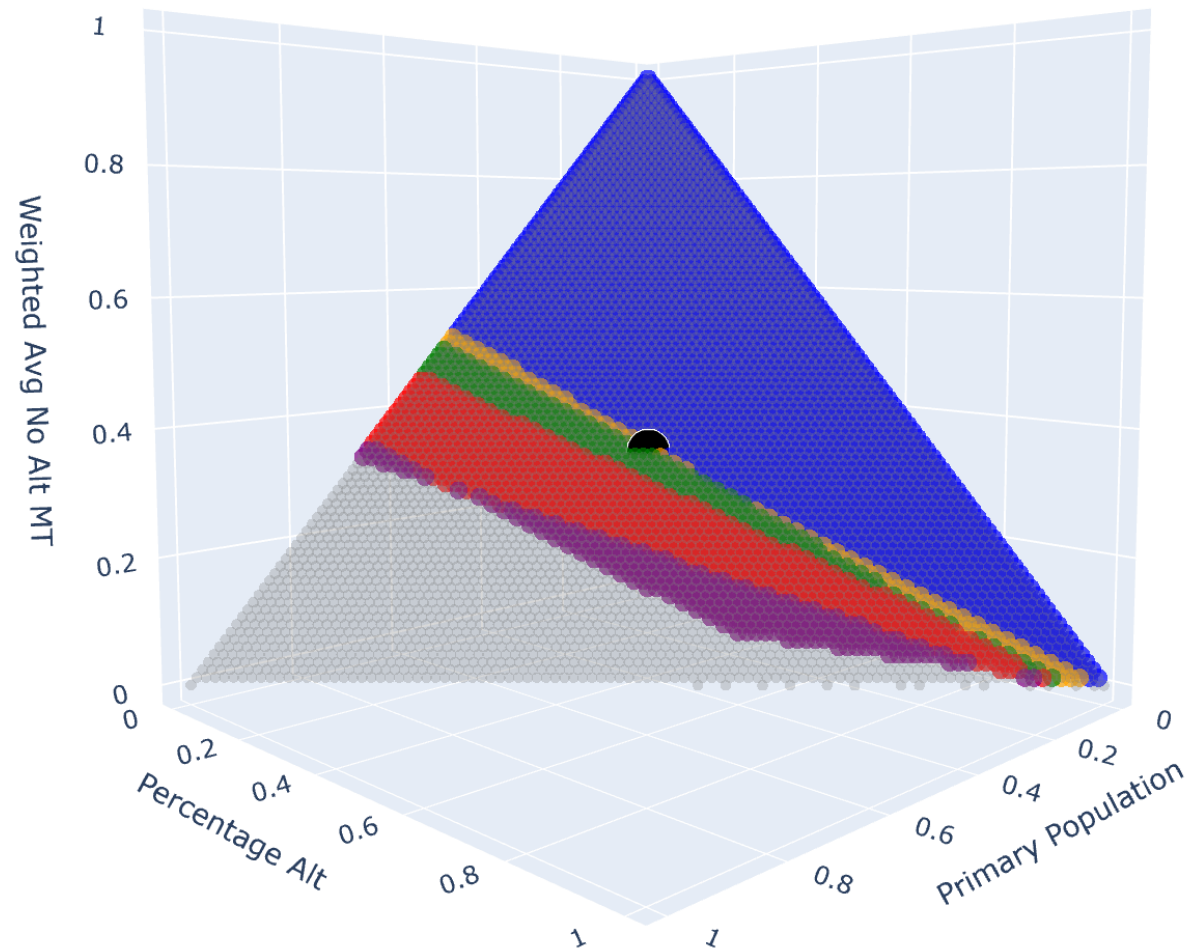
This shows, percentage of combination space each facility appears in each rank within its facility type. For instance, New Orleans Emergency Medical Services is ranked 2 most critical among all EMS 11.2% of the weight combination space.

Criticality – Most Critical Facilities



NEW ORLEANS
LAKEFRONT AIRPORT
AIRCRAFT RESCUE
AND FIRE FIGHTING

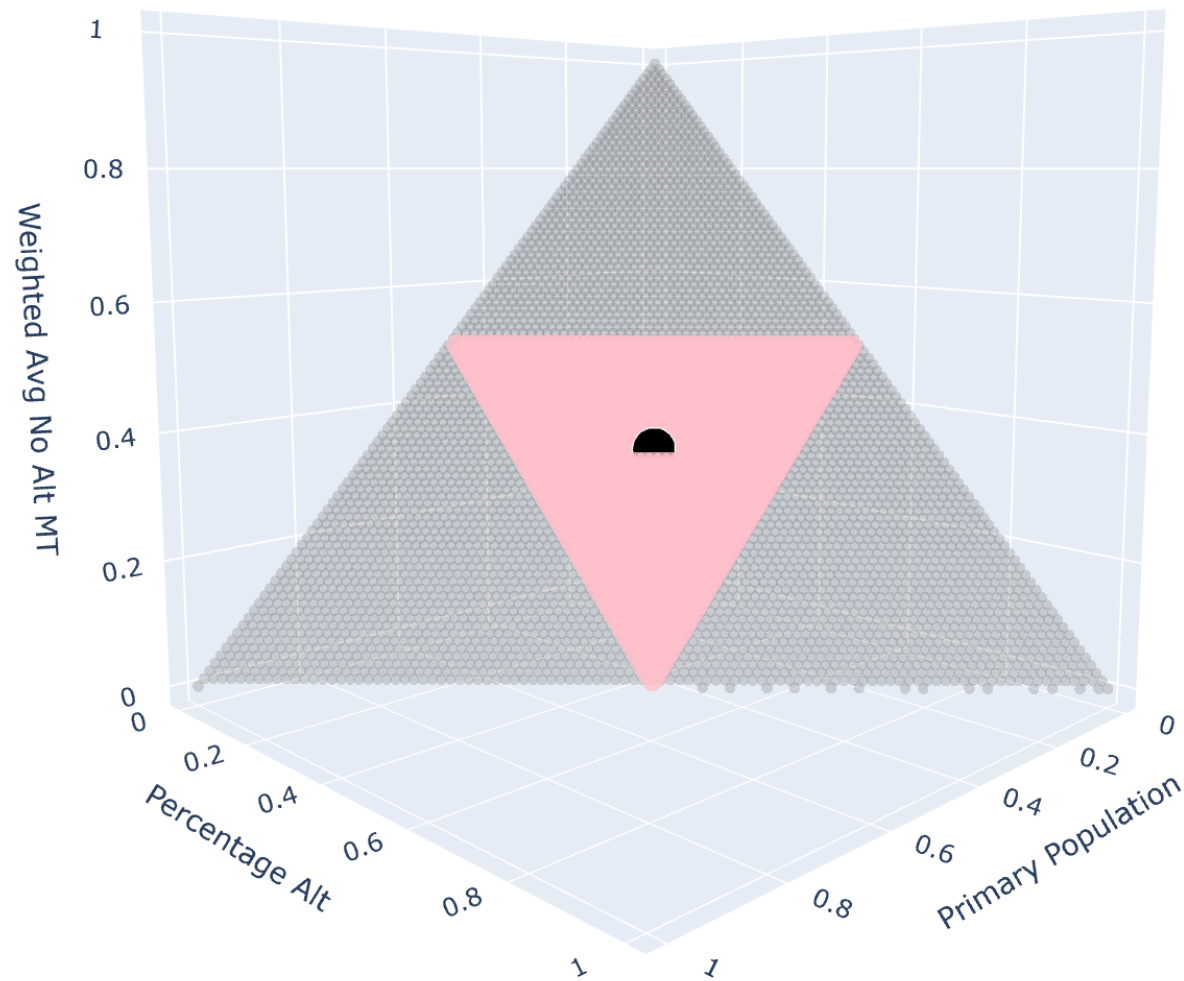
Criticality – Most Critical Facilities



- Rank 1
- Rank 2
- Rank 3
- Rank 4
- Rank 5
- All Weight Combinations
- Equal Weights Point
- Extreme Scenarios

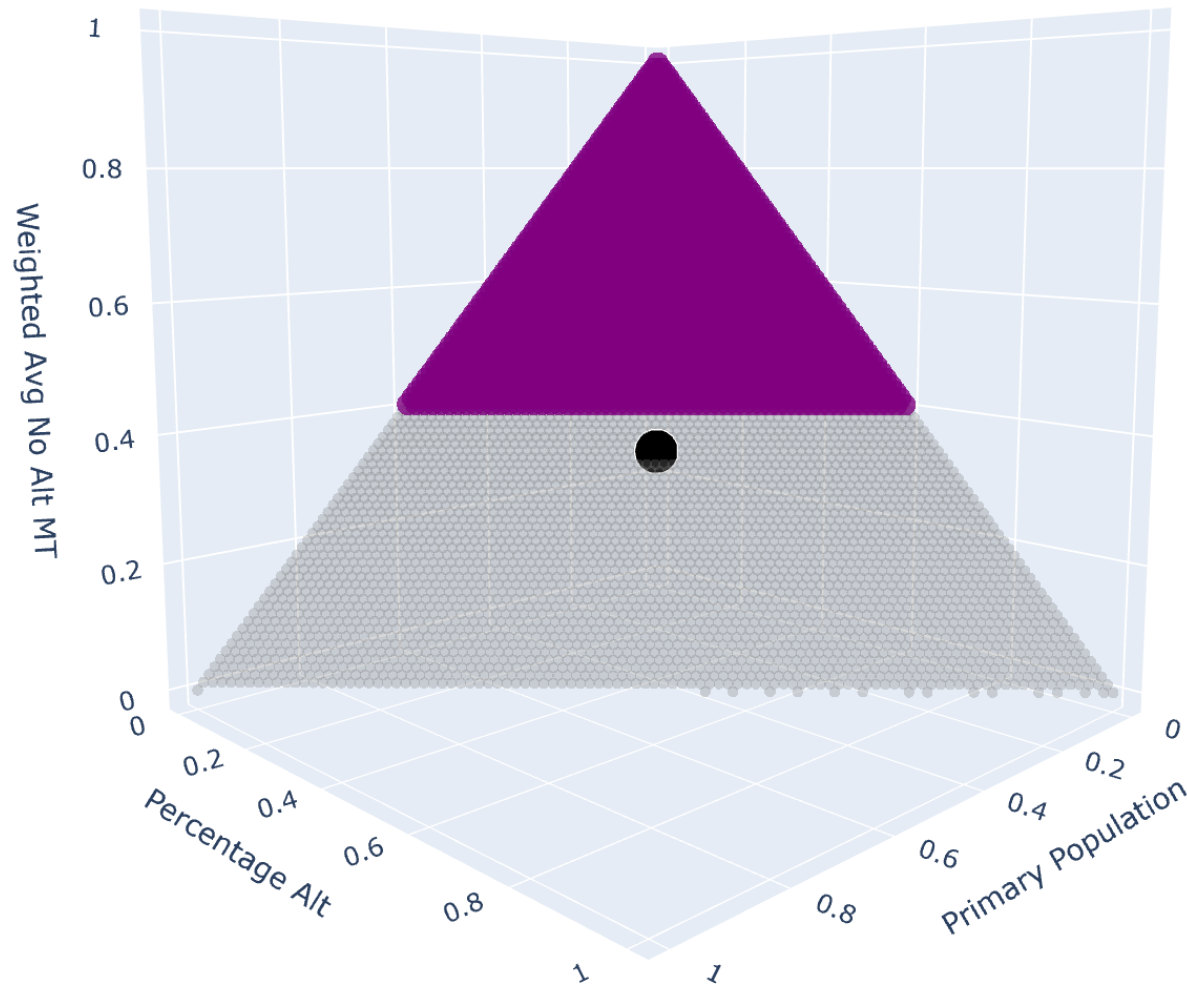
PLAQUEMINES
PARISH AMBULANCE
DEPARTMENT -
WOODLAWN
STATION

Criticality – Most Critical Facilities



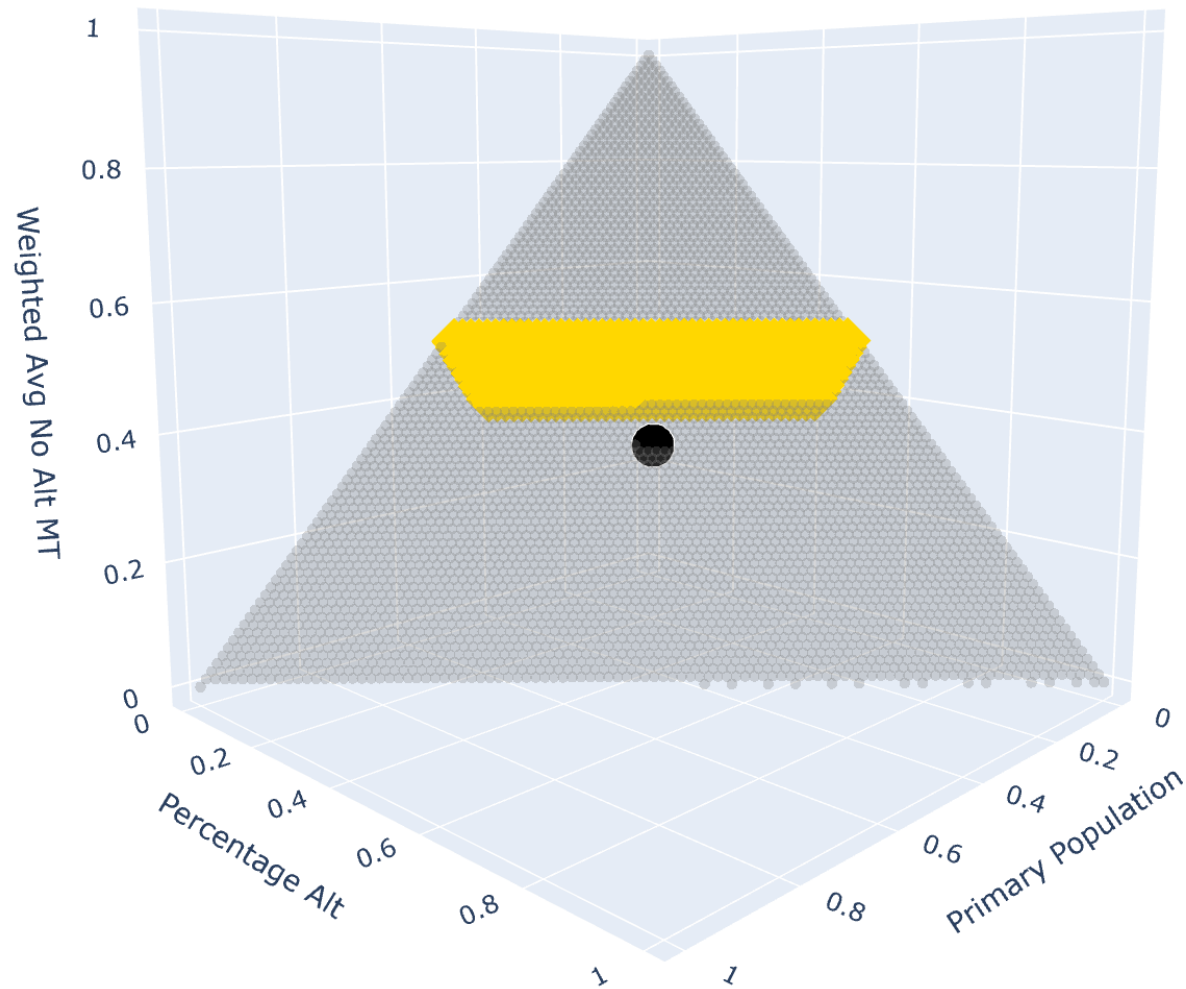
- Rank 1
- Rank 2
- Rank 3
- Rank 4
- Rank 5
- All Weight Combinations
- Equal Weights Point
- Decision Maker 1
- Decision Maker 2
- Overlapping Area

Criticality – Most Critical Facilities



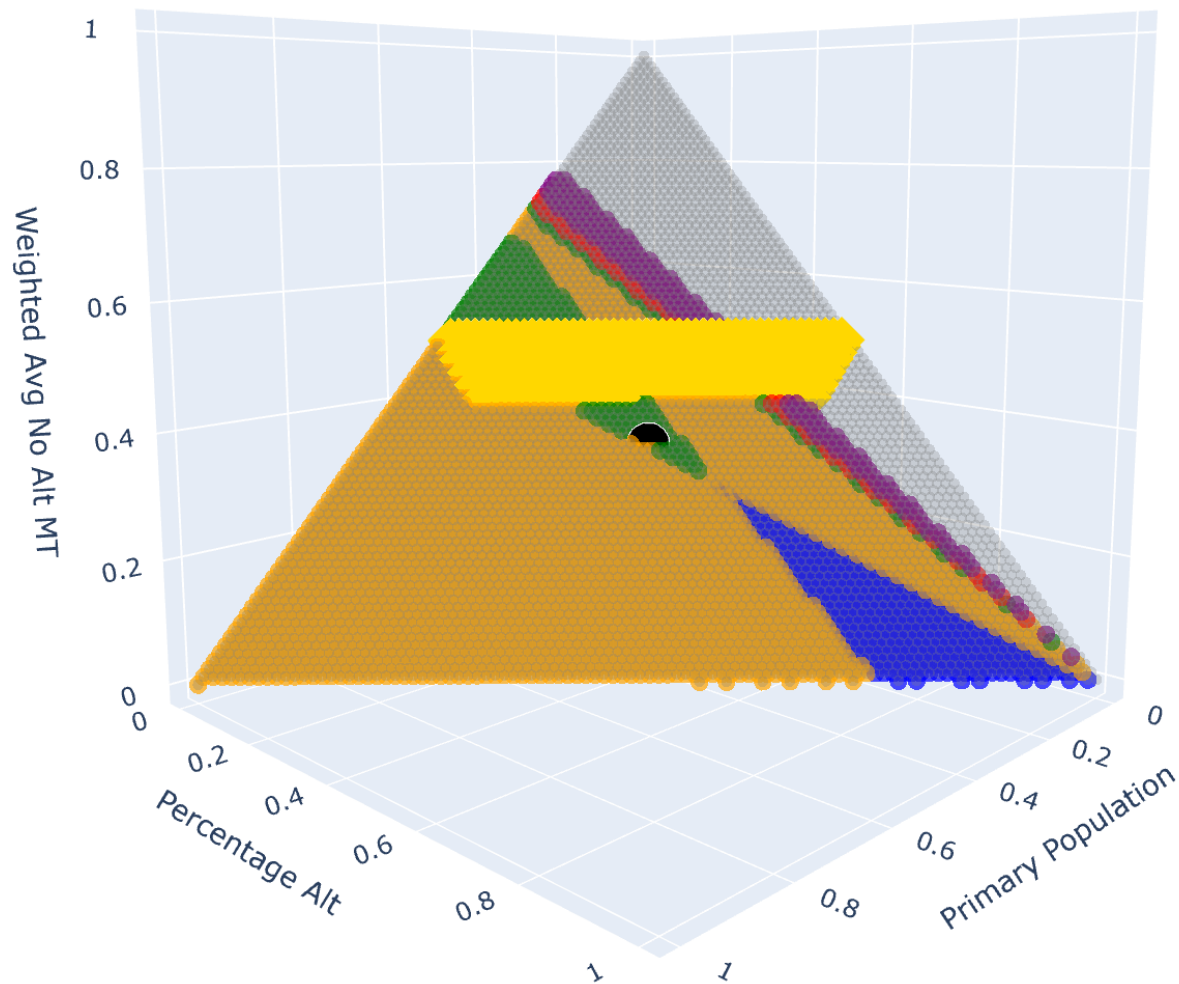
- Rank 1
- Rank 2
- Rank 3
- Rank 4
- Rank 5
- All Weight Combinations
- Equal Weights Point
- Decision Maker 1
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Criticality – Most Critical Facilities



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Criticality – Most Critical Facilities



- Rank 1
- Rank 2
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- Rank 5
- All Weight Combinations
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- Decision Maker 1
- Decision Maker 2
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Conclusion

- Drive-time analysis reveals significant differences in access to primary, secondary, and other essential service locations, **highlighting disparities in fragility across regions.**
- Defining access based solely on the closest locations **overlooks critical aspects of resilience and does not identify the fragility of access.**
- Visualizing criticality in a weight space allows for policy-makers to understand **implication of their preferences.**
- Criticality can be measure somewhat independent of decision maker preferences by overlaying areas in weight combination space and identifying facilities that ranked high in those overlapping areas.

Acknowledgements



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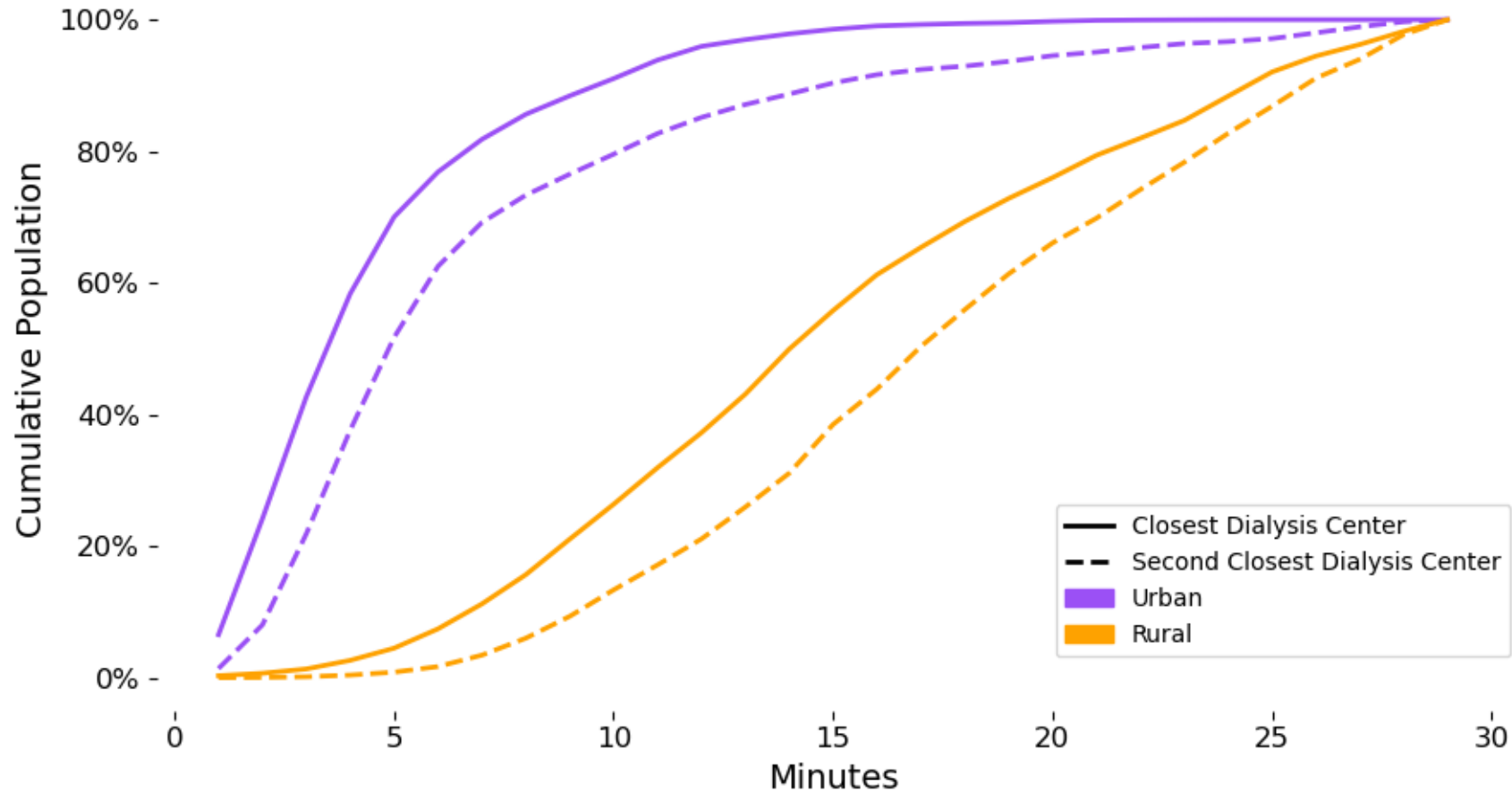
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GULF RESEARCH PROGRAM

THANK YOU!

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Urban – Rural Differences in Fragility: Dialysis Center



Urban – Rural Differences in Fragility: Dialysis Center

