Anchors Against Food Deserts: Gravity Model of Atlanta's Grocery Network Invest Atlanta (Group 2)

Yuhan (Max) Wu [1], Lorayne Gulbrandsen, Jessica (Jiayi) Wang[1], Alice Xu [1]
[1]Department of Data and Decision Sciences, College of Arts and Sciences, Emory University

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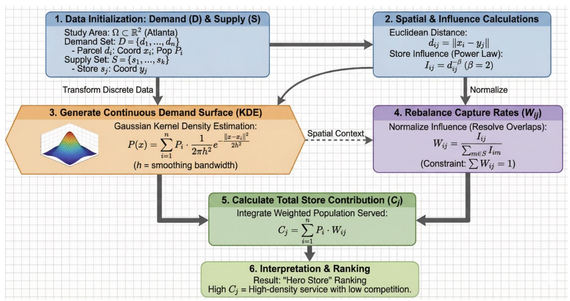
Introduction

Solutions to food deserts are difficult to quantify because of how many factors go into qualifying something as a food desert. Things like income level, transit routes, competing stores, and population density all play a role. Our group chose to narrow our focus down to looking at existing stores and analyzing their impacts on Atlanta's current food network by considering what proportion of the population's fresh food needs is met by each store. This will give Invest Atlanta data on potential grant recipients and more data on how Atlanta's fresh food needs are currently being fulfilled.

Research Goal

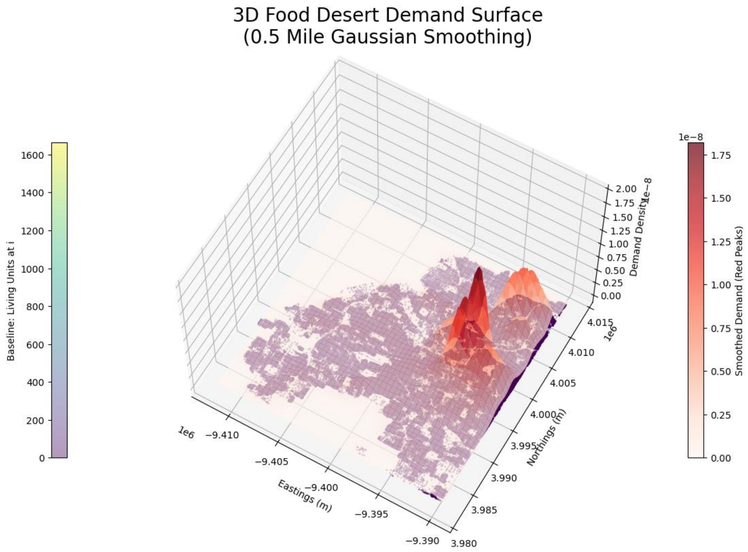
Identify food retail stores that play the most critical role in reducing food desert risk, and use this analysis to prioritize potential grant recipient candidates.

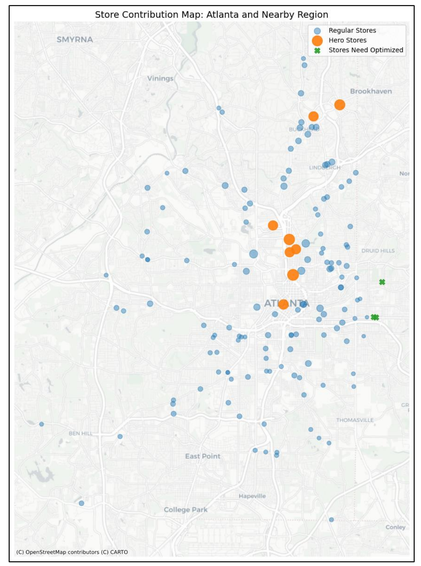
Methods

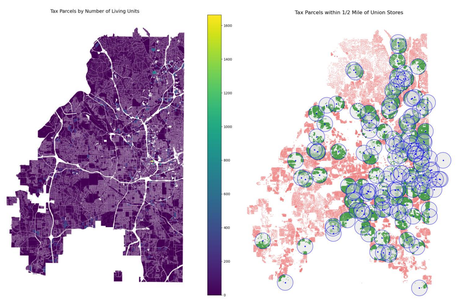


We model Atlanta food access as a gravity-weighted demand surface. Each demand parcel carries a population P_i, and store influence decays with distance as I_ij = d_ij raised to the negative two. We smooth parcel populations into a continuous surface via Gaussian kernel density estimation, then normalize influence into capture rates W_ij that sum to one across stores for each parcel, allocating demand without double-counting. Each store's total contribution C_j is the sum of P_i times W_ij over all parcels; ranking stores by C_j identifies "hero stores" serving dense demand with little nearby competition. Folium and contextily were used for visualization. Pandas, numpy, geopandas, and matplot were used for analysis.

Figures and Results





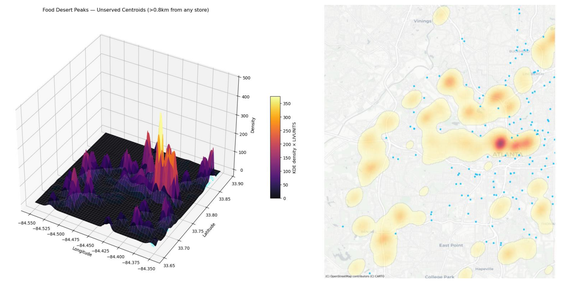


This is what our model finds:

1. As expected, food access demand (tax parcels) in Atlanta is uneven. Urban areas like Midtown and Downtown have higher demand due to a larger number of households.
2. Food access supply (store locations) is also uneven, with stores concentrated in urban areas compared to peripheral regions.
3. Depending on the city's goal (½ mile radius for fresh food access), being close to a store does not always guarantee that demand is fully served.
4. As a result, there are areas where demand remains unmet, especially in outer neighborhoods & between store clusters, indicating gaps in effective food access coverage.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	lon_round	lat_round	longitude	latitude	names	categories	sources	n_sources	contribution_score	contribution_norm	hero	needs_optim	store_label	marker_size
2	-84.38606	33.7685	-84.386064	33.7684962	Eat Right Atlanta - Emory Midtown	Mobile Food	gdf_selected	1	9517.741836	1	TRUE	FALSE	Hero Store	250
3	-84.38827	33.78586	-84.388266	33.7858568	Whole Foods Midtown	Grocery Stor	gdf_selected	1	8632.789805	0.907020799	TRUE	FALSE	Hero Store	229.544576
4	-84.3585	33.85182	-84.3585	33.8518241	Publix Lenox | Target PeachtreeLenox	Grocery Stor	gdf_selected	1	7874.275308	0.827326003	TRUE	FALSE	Standard Sto	212.011721
5	-84.3917	33.75399	-84.391697	33.7539909	MARTA Market - Five Points Fresh	Farmers Mar	gdf_selected	1	6683.213455	0.70218478	TRUE	FALSE	Standard Sto	184.480652
6	-84.37397	33.84615	-84.373972	33.8461503	Publix Super Markets, Inc.	Grocery Stor	df_grocery_s	1	6286.780026	0.660532733	TRUE	FALSE	Standard Sto	175.317201
7	-84.39787	33.79273	-84.397871	33.7927258	Publix Super Market Atlantic Station	Grocery Stor	gdf_selected	1	6213.269036	0.652809158	TRUE	FALSE	Standard Sto	173.618015
8	-84.38804	33.7796	-84.388044	33.7795993	Publix West Peachtree Midtown	Grocery Stor	gdf_selected	1	6212.744125	0.652754007	TRUE	FALSE	Standard Sto	173.605882
9	-84.38431	33.78105	-84.384308	33.7810517	Savi Provisions	Neighborhoo	gdf_selected	1	6008.939999	0.631340932	TRUE	FALSE	Standard Sto	168.895005
10	-84.40933	33.77874	-84.409328	33.7787401	ARDEN GARDEN	Grocery Stor	df_grocery_s	1	5629.837557	0.591509799	FALSE	FALSE	Standard Sto	160.132156
11	-84.37858	33.7839	-84.37858	33.783898	Green Market at Piedmont Park	Farmers Mar	gdf_selected	1	4791.854963	0.503465533	FALSE	FALSE	Standard Sto	140.762417
12	-84.38117	33.7705	-84.381175	33.7704954	Publix Piedmont	Grocery Stor	gdf_selected	1	4241.786643	0.445671538	FALSE	FALSE	Standard Sto	128.047738
13	-84.37013	33.75209	-84.370127	33.7520916	Midtown Pantry, LLC	Grocery Stor	df_grocery_s	1	3393.026631	0.356494922	FALSE	FALSE	Standard Sto	108.428883
14	-84.40737	33.75269	-84.407371	33.7526893	Goodr at APS Services Hub	Emergency F	gdf_selected	1	3014.31335	0.316704677	FALSE	FALSE	Standard Sto	99.6750289
15	-84.39141	33.81195	-84.391414	33.8119486	The Fresh Market PeachtreeRd	Grocery Stor	gdf_selected	1	2994.172624	0.314588552	FALSE	FALSE	Standard Sto	99.2094815
16	-84.37991	33.75402	-84.379914	33.7540215	The Municipal Market- Sweet Auburn	Neighborhoo	gdf_selected	1	2837.686966	0.298147083	FALSE	FALSE	Standard Sto	95.5923583

Conclusion



Our analysis identifies "hero stores," or existing food businesses that play the biggest role in preventing nearby areas from becoming food deserts. Based on our gravity weighted food access model, the top three hero stores are Eat Right Atlanta - Emory Midtown(9517.74), Whole Foods Midtown (8632.79), and Publix Lenox | Target PeachtreeLenox (7874.28).

These stores have the highest contribution scores because they serve areas with strong nearby demand and relatively fewer competing food access options.

Assuming each store covers a half-mile radius, the parcels that still need coverage are the unserved parcels with the highest heat map peaks.

Potential Improvements

Replace Euclidean distance with road-network travel time and layer in MARTA stops and bus frequency,
Weight parcels by income, vehicle access, or SNAP eligibility rather than treating every resident as equally constrained,
and differentiate stores by type so a full-service grocer counts differently from a convenience store with limited produce.
Extend the model over time to flag hero stores that are also financially at risk — the cases where intervention from Invest Atlanta would be most urgent.

Datasets Used

We used Atlanta tax parcel boundaries with population estimates as demand, business license records as supply, and the Aglanta FFA shapefiles to delineate existing food-access and low-income/low-access areas. Datasets were provided by InvestAtlanta. All datasets are from 2025 or later. We chose not to use the SNAP dataset since the boundaries were inconsistent and not to use LILA because it was outdated.