

Food Delivery as a Tool Against Food Deserts

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Why This Matters: The Food Desert Crisis

40% of low-income Cook County census tracts classified as food deserts

- Low income + low geographic access to supermarkets
- ~1 million residents affected

Why this matters for ML

Your model predicts whether a tract is a food desert using:

- **Demographics:** race composition, vehicle access
- **Economic indicators:** income, poverty, SNAP
- **Vulnerability:** children + seniors
- **Access trends:** 2019 vs 2025 SNAP intensity changes

The delivery question: Can apps solve this? Or do fees/markups create new barriers?



Data

1. USDA Food Access Research Atlas 2019 (Food Deserts)
 - a. 73,000+ rows of food desert identification data
 - b. Key variables: Low income/access flags, poverty rates, distance to supermarkets
 - c. URL: <https://www.ers.usda.gov/data-products/food-access-research-atlas/download-the-data/>
2. US Census Bureau API (Demographic Data)
 - a. API: https://api.census.gov/data/key_signup.html
3. Supplemental Nutrition Assistance Program (SNAP) Participation Data
 - a. County Level Participation and Issuance Data
 - b. State Level Participation and Issuance Data
 - c. URL: <https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap>



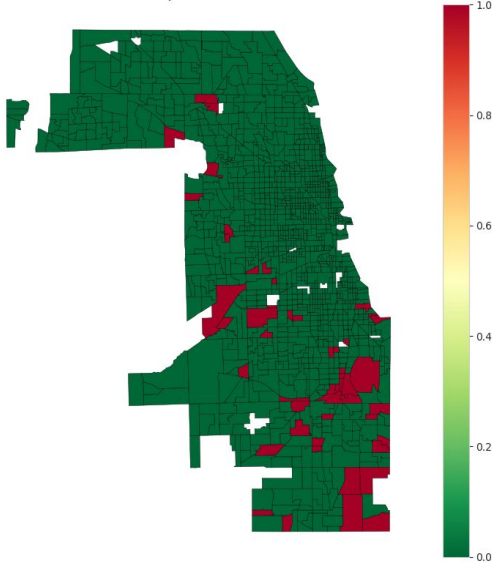
Data

4. Census TIGER/Line Shapefiles (GEOGRAPHIC BOUNDARIES)
 - a. Supports geospatial analysis of food deserts across Chicago
5. Grocery Store Status
 - a. URL:
<https://data.cityofchicago.org/Health-Human-Services/Grocery-Store-Status-Map-Historical/rish-pa6g>
 - b. Historical dataset showing openings/closures of grocery stores
 - c. Helps analyze how store availability changes over time

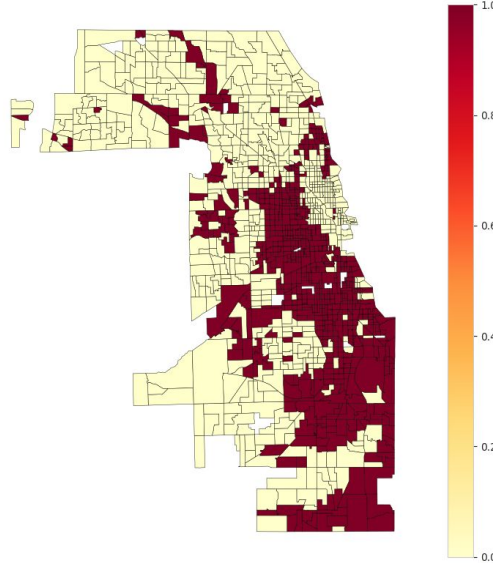


Hypothesis 1: Food delivery coverage is negatively correlated with traditional food desert metrics

Food Deserts in Cook County (Chicago)
Red = Food Desert, Green = Not Food Desert



Low Income Census Tracts in Cook County
Darker = Low Income Areas



Finding: Visualization shows concentration patterns in certain regions.

- Out of 1,314 census tracts, only 51 are classified as food deserts. This reveals that these food deserts are concentrated in specific regions rather than scattered randomly. This suggests that while food deserts affect a small portion of the county overall, certain neighborhoods face limited access to grocery stores.
- Since only 3.9% of Cook County are food deserts this indicates it's not a major county-wide issue.

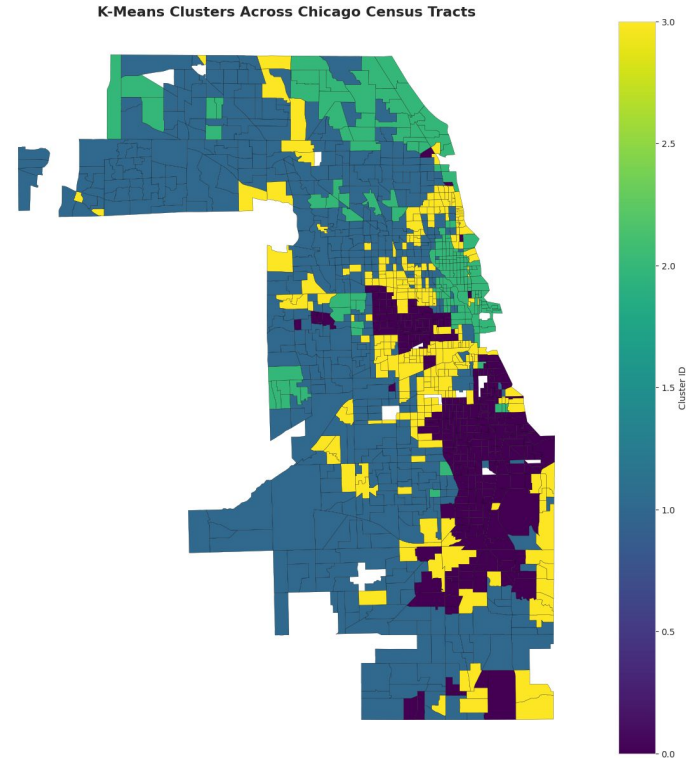
Hypothesis 1: Food deserts cluster in specific geographic areas

This figure shows a geographic map of Chicago in which each census tract is shaded according to its assigned K-Means cluster (0, 1, 2, or 3).

Lower-income neighborhoods with higher poverty levels (Clusters 0 and 3) are mainly on the South and West Side).

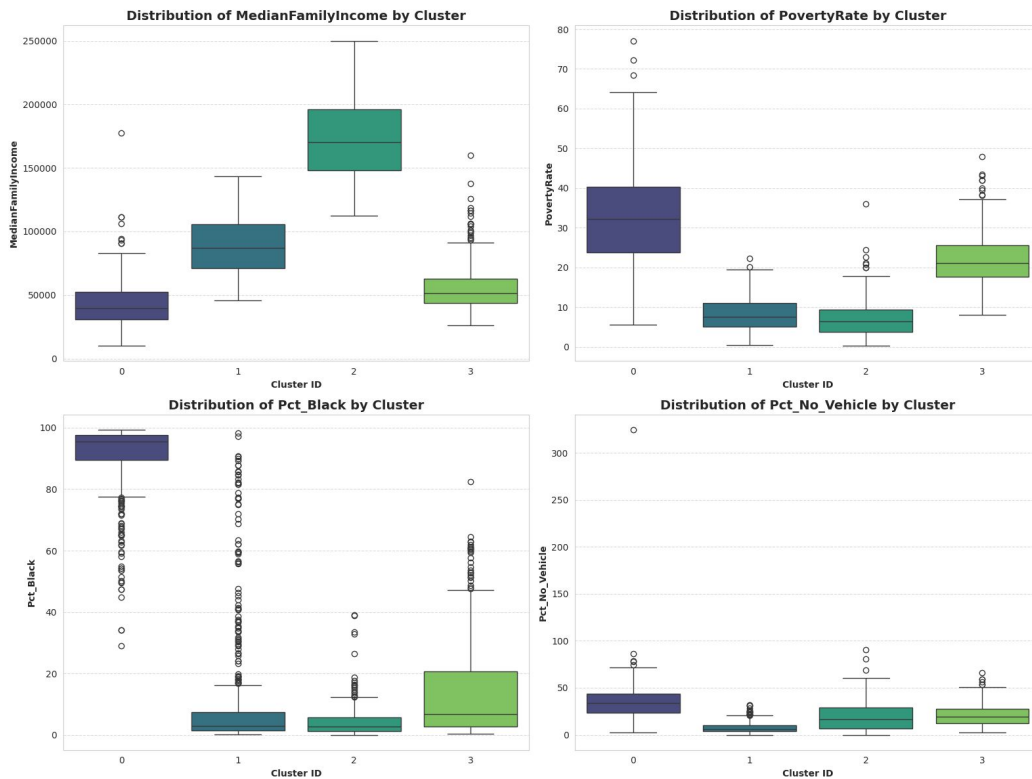
Higher-income areas with lower poverty (Clusters 1 and 2) are mostly on the North Side, downtown, and Northwest Side.

Overall, this spatial organization shows that food access and economic challenges are concentrated in specific parts of the city.



Hypothesis 1: Food deserts cluster in specific geographic areas

K-Means Cluster Characteristics





Hypothesis 2: Delivery services improve food access but may not address affordability barriers for low income populations

OPTIMISTIC VIEW: Delivery brings groceries to people who can't reach stores.

REALISTIC CONSTRAINT:

- Delivery adds 15–25% markup (platform fees, delivery charges)
- Minimum orders (\$15–\$35) incur small order fees and delivery charges
- Low-income families spend 30–40% of income on food already
- They cannot absorb additional costs

THE QUESTION: Even if delivery reaches food deserts, can residents afford to use it?

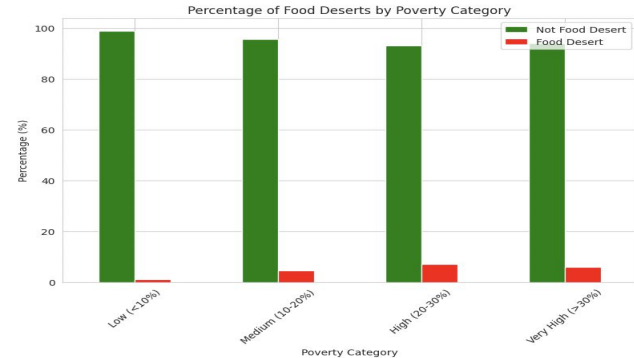
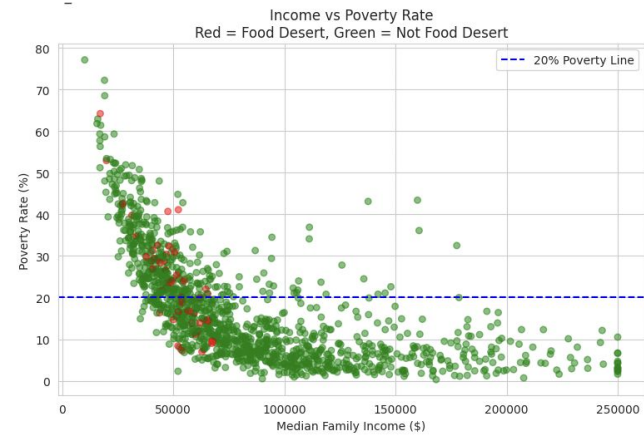
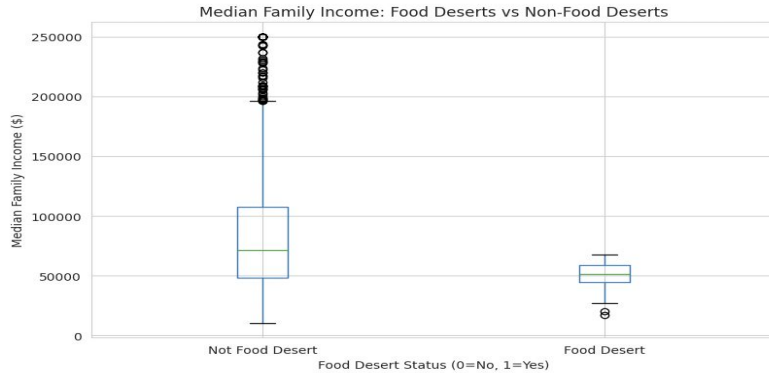
If H2 is TRUE:

- Delivery benefits affluent customers; poor stay excluded
- New form of inequality: "digital food inequality"

If H2 is FALSE:

- Delivery affordability is less of a barrier than we thought
- May be viable solution with proper subsidy

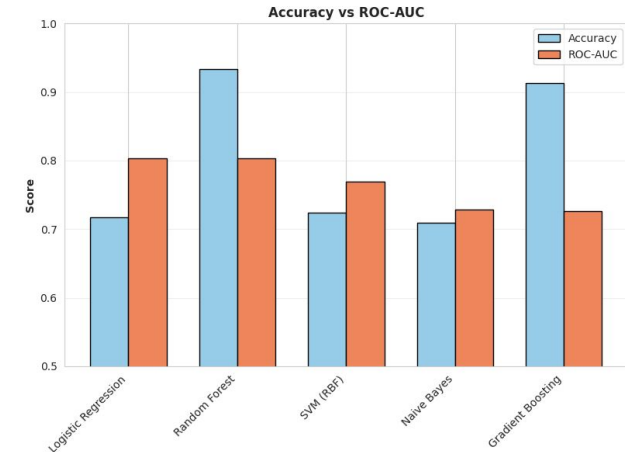
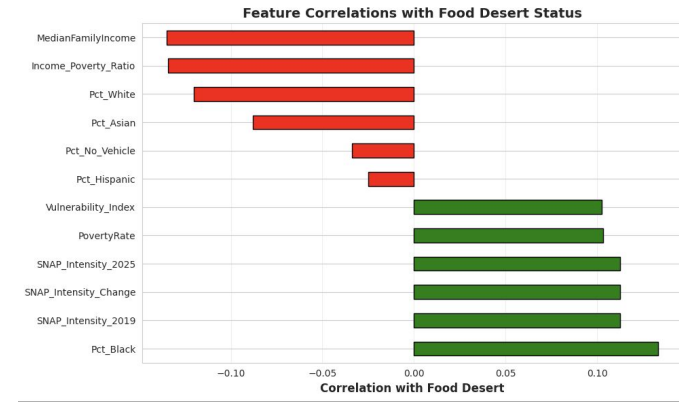
Hypothesis 2: Delivery services improve food access but may not address affordability barriers for low income populations



ML Results: What Predicts Food Deserts?

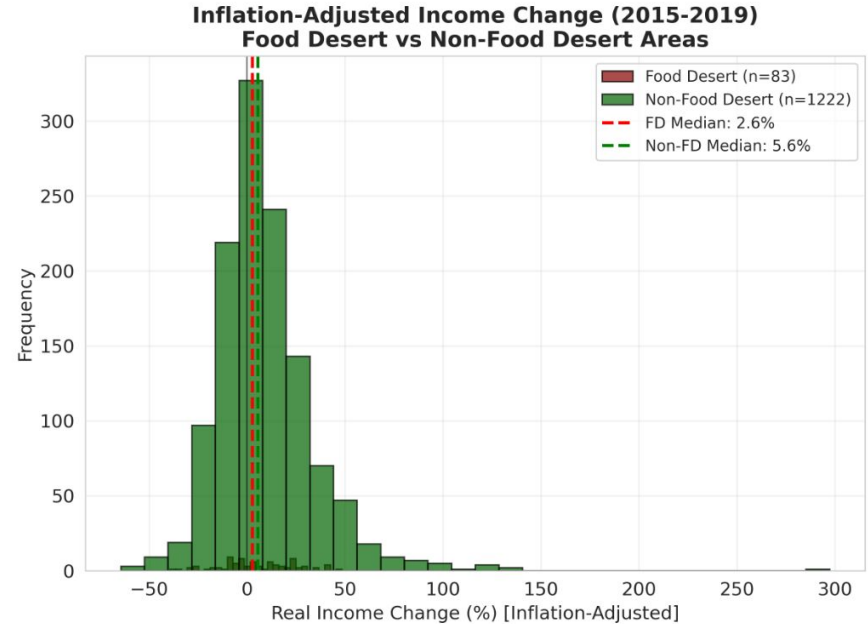
KEY FINDINGS

- Affordability > Distance
- Model strong: ROC-AUC 0.79, 76% of food deserts identified
- Top features all economic: SNAP, income, poverty, no vehicle
- SNAP +6.2% (2019–2025) — poverty worsening
- Insight: Delivery needs money, but food deserts lack it



Hypothesis 3: Income Disparity & Food Access in Chicago

- Hypothesis: Income decline in food desert regions, contrasted with inflation-adjusted growth in wealthier Chicago areas, has widened food access disparities
- Datasets Used:
 - Food Access Research Atlas (2015 & 2019)
 - SNAP Participation Data (2015, 2019, 2025)
 - Census Tract Shapefiles (Cook County)
- Practical significance: Food desert regions consistently underperforming in income growth.

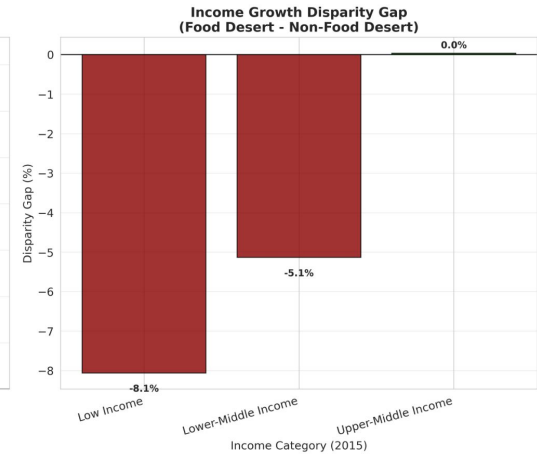




Hypothesis 3: Key Findings & Visualizations

Metric	Food Desert	Non-Food Desert
Mean Real Income Change	5.37%	9.10%
Median Real Income Change	2.64%	5.56%
Negative Income Change	43.4%	38.0%

- Disparity Gap: 3.74 percentage points
- Low-income food deserts: 8.1% lower income growth than non-food desert counterparts
- SNAP correlation with income: -0.589 (strong negative)





Hypothesis 3: ML Analysis & Conclusions

→ Classification Model (Food Desert Prediction)

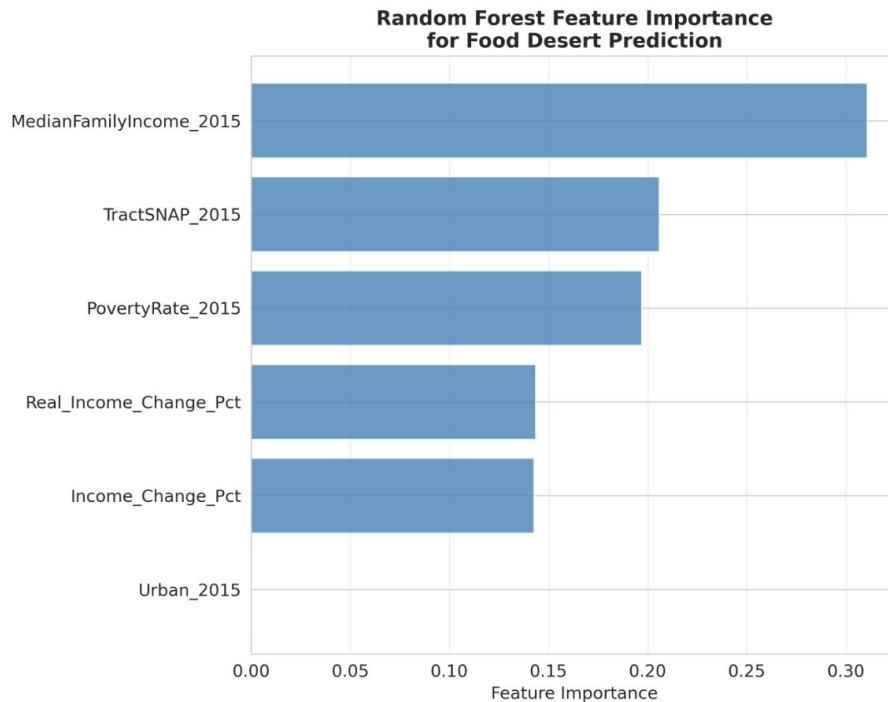
- Best (by F1): Logistic Regression (ROC-AUC = 0.825)
- Top predictors: Median Income, SNAP participation, Poverty Rate

→ Regression Model (Income Change Prediction):

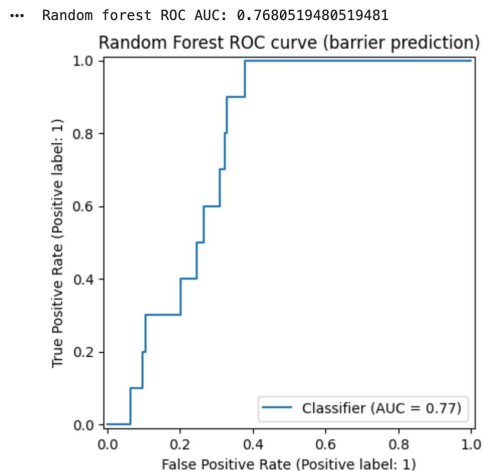
- Linear Regression outperformed ensemble methods
- Key features: Income level, SNAP recipients, low-access metrics

→ Conclusion:

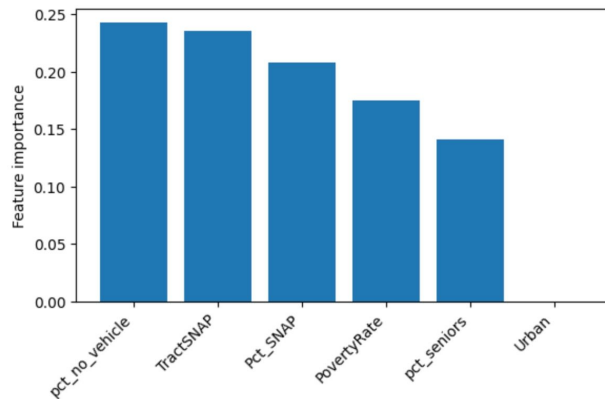
- Descriptive evidence suggests widening disparity.



Hypothesis 4: Broadband adoption gaps, not service availability, are the primary digital food access barrier in urban food deserts—exacerbated by poverty and elderly populations.



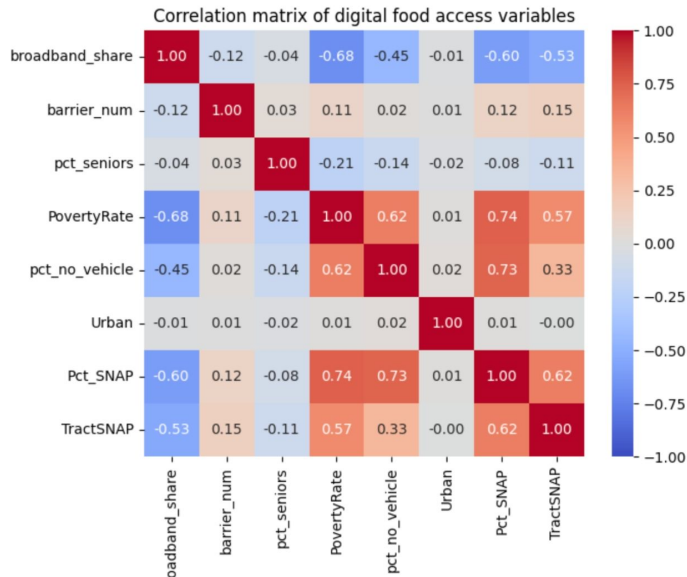
Random Forest model achieves 77% AUC in identifying barrier tracts—excellent discrimination enabling targeted policy interventions.



What Drives Digital Food Access Barriers?

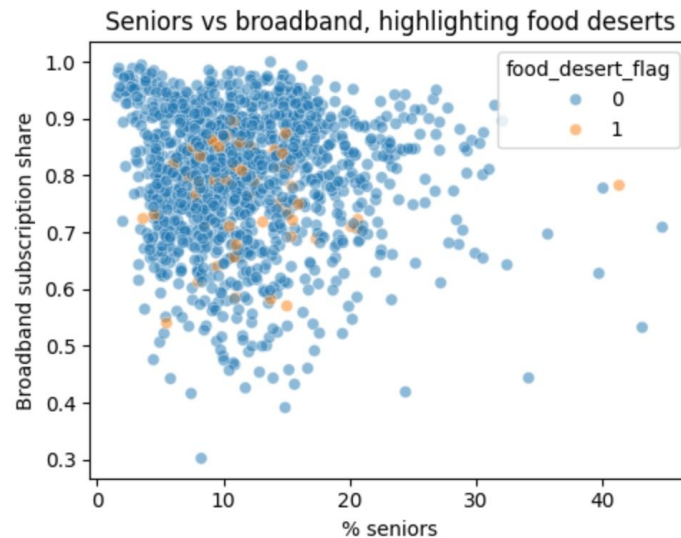
- Poverty: -0.68 correlation with broadband
- SNAP participation: -0.60 correlation with broadband
- Senior share: -0.04 correlation with broadband

32 barrier tracts identified in Cook County: neighborhoods facing triple disadvantage (food desert + low income + below-median broadband)



Orange points (food deserts) cluster in the lower-right quadrant (high seniors, low broadband), where food deserts concentrate, broadband adoption is lowest among elderly neighborhoods.

Poverty and vehicle access are the strongest predictors of barrier tracts—poverty has 2.4x higher importance than senior share, yet elderly populations remain a significant independent risk factor.



Hypothesis 5: Higher digital access barriers are more likely to be food deserts.

A composite Digital Barrier Index from 4 standardized components:

- Broadband Access
- Senior Share (digital literacy)
- SNAP Recipient
- No Vehicle

Each component is z-score standardized, then summed to create the index.

Key Correlations with Food Desert:

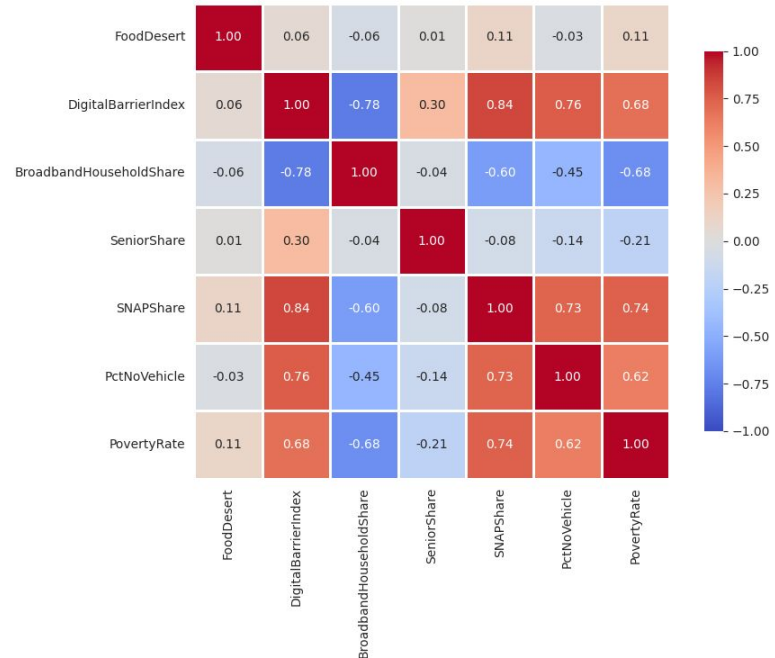
Digital Barrier Index: $r = +0.058$

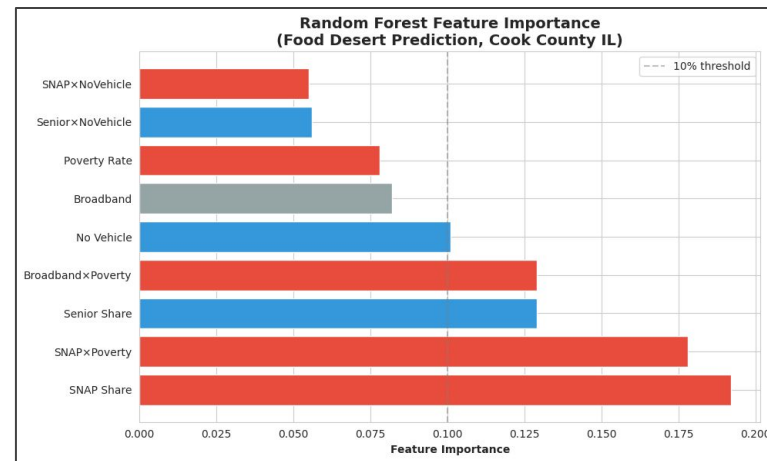
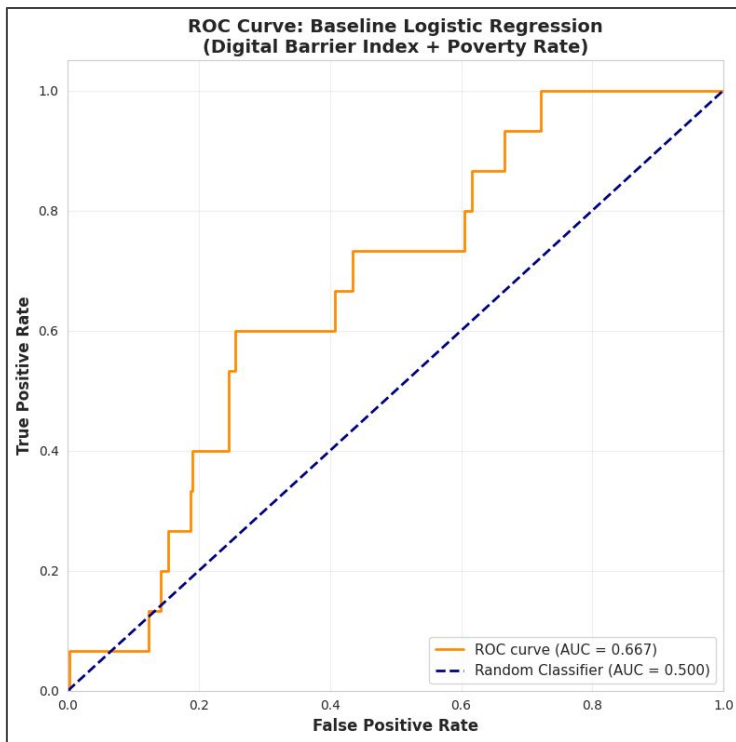
Broadband Access: $r = -0.057$

No Vehicle %: $r = -0.028$

SNAP Share: $r = +0.110$

Correlation Matrix: Digital Barriers and Food Desert Status





Model Performance Comparison:

Baseline (2 features): ROC-AUC = 0.667

Balanced (2 features): ROC-AUC = 0.658

Expanded (5 features): ROC-AUC = 0.820

Improvement: +0.152



Challenges:

Coordinates and mapping: Some tracts lacked latitude/longitude, making location mapping tricky.

Missing values: Demographic and economic data were incomplete and needed careful handling.

Data merging and null values: Combining multiple datasets sometimes produced null values due to mismatched columns and formats.

Data Collection for Online Delivery coverage: Manual collection of data for online delivery coverage had to be done due to restrictive web scraping policies by big organizations like Amazon, Walmart etc.



Conclusion

- 51 of 1,314 Cook County tracts (3.9%) are food deserts, clustered in specific regions with 55.1% Black population vs 28.8% in non-food desert areas
- Food desert areas average 24.0% poverty vs 16.9% in non-food desert areas (7.1 percentage point gap)
- Median income growth only 2.6% (2015-2019) compared to 5.6% elsewhere; 43.4% of food desert tracts saw negative income change
- SNAP is the #1 predictor (19% importance), SNAP participation up 6.2% in food deserts since 2019, and delivery markups add 15-25% on top of already stretched budgets
- Identified 32 "barrier tracts" with food desert + low income + low broadband
- Bottom line: Food deserts = affordability problem, not access problem. Delivery apps help people with money, not people without it.



THANK YOU

ANY QUESTIONS?