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Developing a Data-driven Approach to inform Planning in County Health and Human Services Departments in the Context of a Case Study on Obesity

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Abstract
Since the 1970s, the obesity rate has steadily increased due to growing availability of food and declining physical activity. The existing environments within a community, including active recreation opportunities, access to healthy food options, the built environment, and transportation options, can moderate obesity. In Virginia, Fairfax County Health and Human Services (HHS) system is interested in developing the capacity for data-driven approaches to gain insights on current and future issues, such as obesity, to characterize factors at the county and sub-county level, and to use these insights to inform policy options. In exploring these questions, we developed statistical methods to combined data from a multitude of different sources including local administrative data (e.g., tax assessments, land use, student surveys), place-based data, and federal collections. Using synthetic data methods based on imputation, we recomputed American Community Survey statistics for non-Census tract geographic regions for political districts and high school attendance areas. We combined this with environmental factors, such as land dedicated to parks and recreation facilities, as well as measures of the density of healthy and unhealthy food locations to create a map of potentially obesogenic factors. Finally, we combined these data sources with Fairfax County's youth survey and trained a random forest model to predict the effects of the environment on healthy food consumption and exercise. Our analysis highlights the need for (administrative) data at a fine scale and recommends policy changes concerning the recording and sharing of local data to better inform the policy and program development.

Comments
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Developing a Data-driven Approach to Inform Planning in County Health and Human Services Departments: Case Study on Obesity

ADRF November 2018

Sessions - *Uses of Administrative Data for Supporting Public Programs and Public Health Policy*

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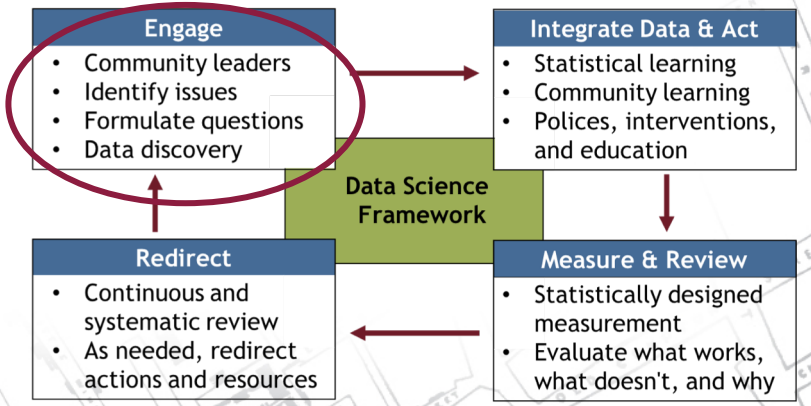
Engagement, Issues, & Questions

Overarching Goal: Develop data-driven insights on current issues and build forecasts to inform future issues

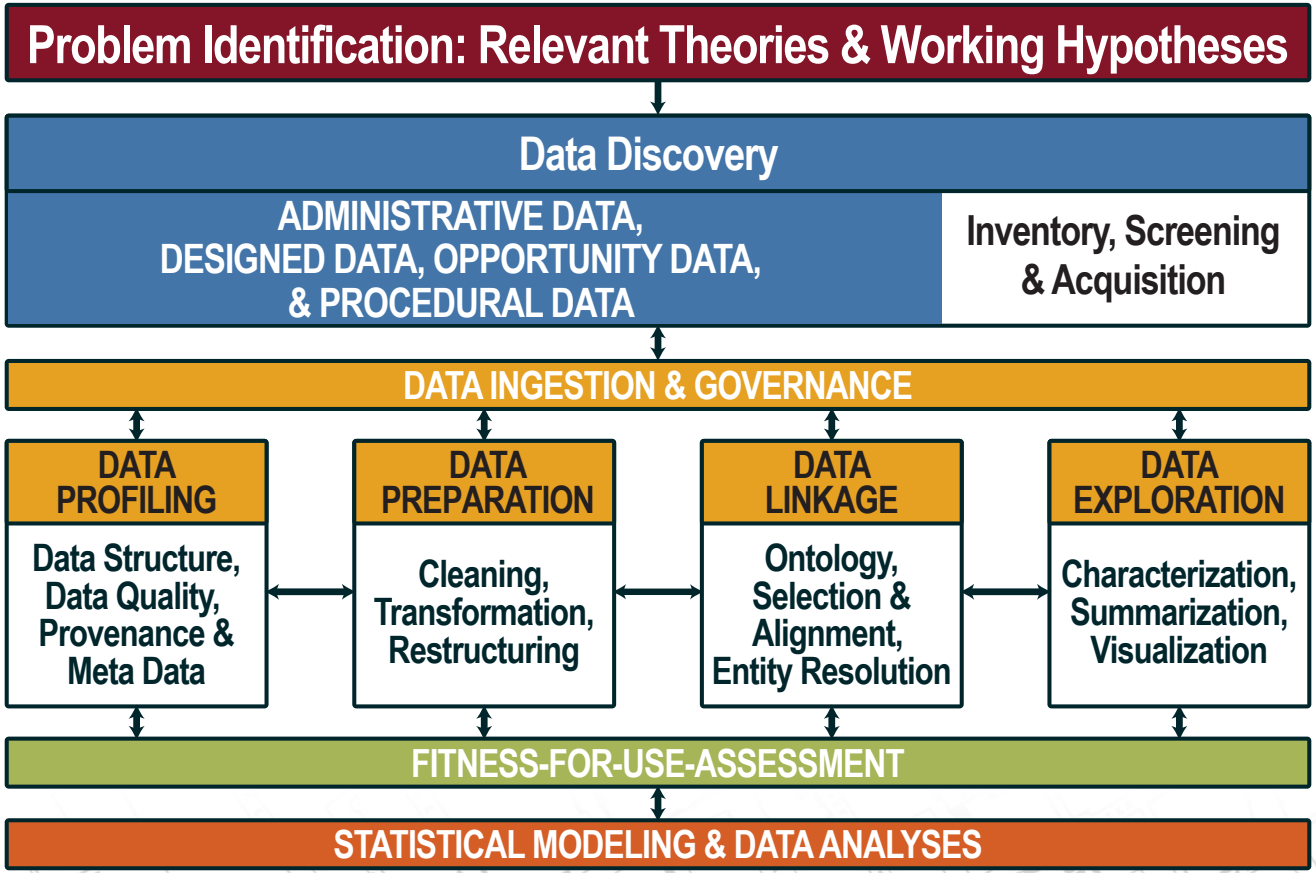
- Expand Fairfax County's capacity to access and integrate county, state, and federal data in useful ways to address critical problems

Project Focus: Identify the trends in obesity and activities related to obesity across geographies of interest for local policy and program development

- Focus on determinants identified in the literature related to obesity – the built environment, nutrition, physical activity, family support, demographic and economic characteristics

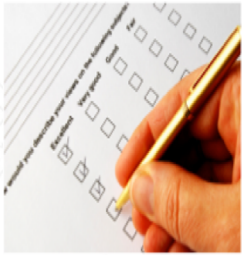


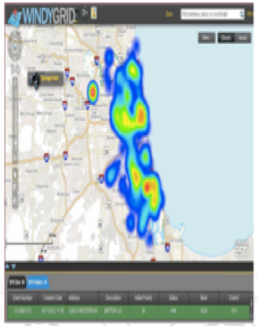
Data Science Framework



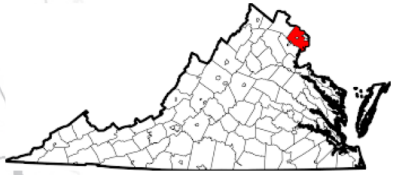
Data science innovations to develop *sub-county* data-driven insights

- Data Discovery – identify all types of data
- Synthetic information technology
- Geocoding housing units and locations of interest
- Vulnerability Composite Indicators
- Exploring the data using **visualization tools**





Fairfax County, Virginia



Population: 1.1M
Size: 6.3 sq. mi.
Unemployment rate: 3%
Race: 51% white

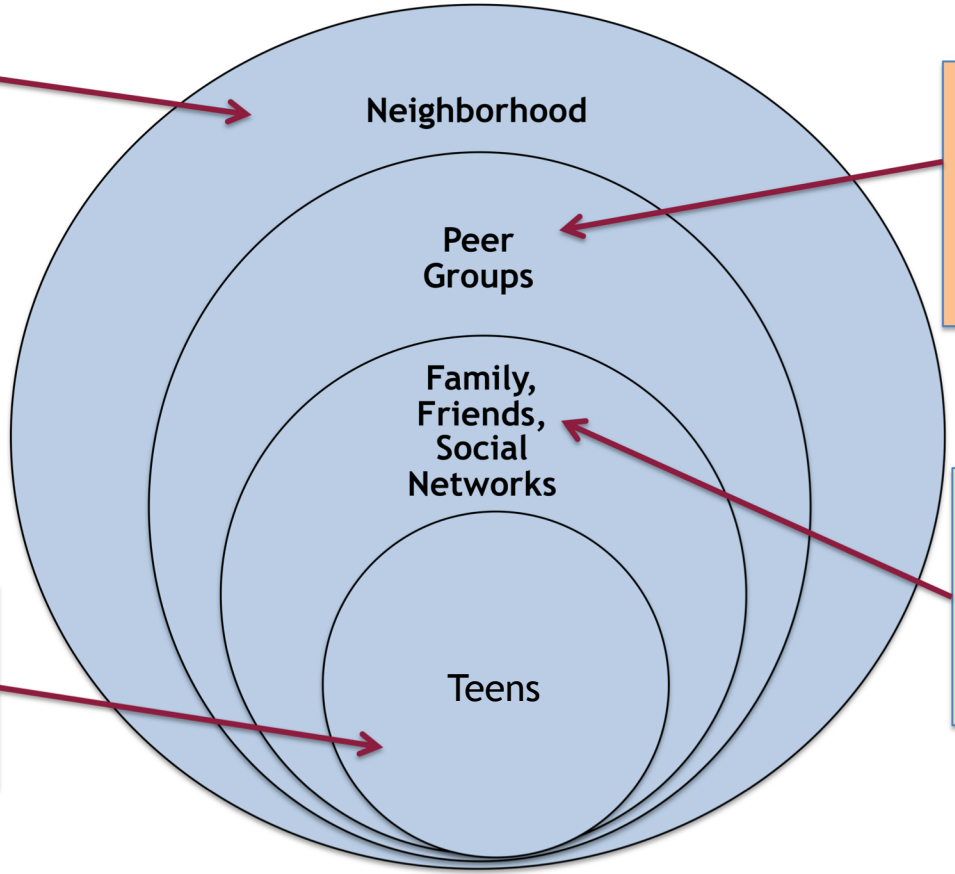
Overarching Goal: Expand Fairfax County's capacity to access and integrate county, state, and federal data to address critical problems and build forecasts to inform future issues

Project Focus: Identify trends in youth obesity, access to healthy food, and physical activities across geographies of interest for local policy and program development

Data Discovery - Local community Data Map

Healthy eating and physical activity of teens

- Access to healthy food - grocery stores, community gardens, farmers markets, restaurants (fast food, other)
- Living Conditions
- Personal Safety
- Engagement
- Support Networks



- Education
- English Literacy
- Health Literacy
- Engagement
- Support Networks

- Family Stability
- Income Stability
- Living Conditions
- Health Literacy
- Support Networks

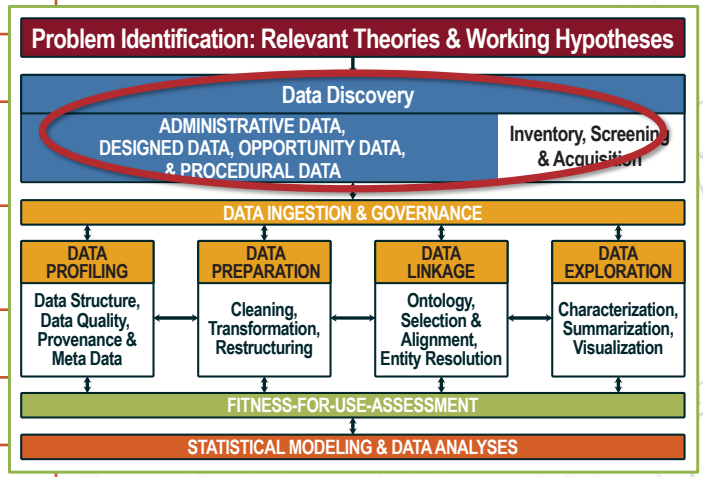
- Behavioral Health
- Physical Health
- Social Wellness
- Support Networks

Data Discovery, Inventory & Acquisition

Data Source	Geography
American Community Survey data (Census), 2011-2015 **(updating now to 2012-2016)**	Census Tracts and Block Groups
American Time Use Survey (BLS), 2017	National
Youth Risk Behavior Surveillance System, 2015	State
County Health Rankings, 2017	County
Built Environment, e.g., Grocery stores, SNAP retailers, recreation centers, community gardens	Address Level
Fairfax real estate tax assessment data	Address Level
Fairfax Open data: Zoning, Environment, water, Parks, Roads	Shapefiles
Fairfax County Youth Survey, 2016 8th, 10th, 12th graders	High School Attendance Area
Virginia Department of Education, 2017	High School
National Center for Education Statistics, 2014-2015	High School
Center for Disease Control, 2014-2015	High School

Initial data sources used with geographic specificity

- **All** are **updated** as new data are available



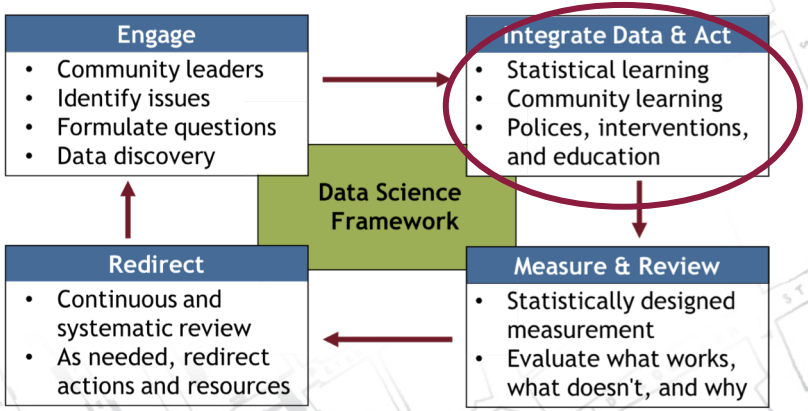
Re-Distribution of Data & Estimates Across Geographies

Problem - Data do not align with geographies of interest, e.g., Supervisor Districts and School Boundaries

Solution - Use data **direct aggregation**, if possible, alternatively develop **synthetic populations** based on data and redistribute

Synthetic re-distribution based on variables of interest

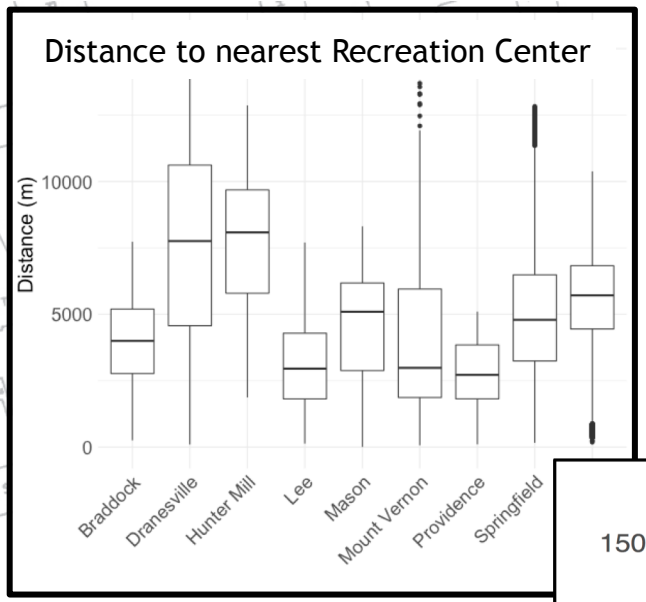
- Iterative Proportional Fitting (IPF)
- Multivariate Imputation by Chained Equations (MICE)

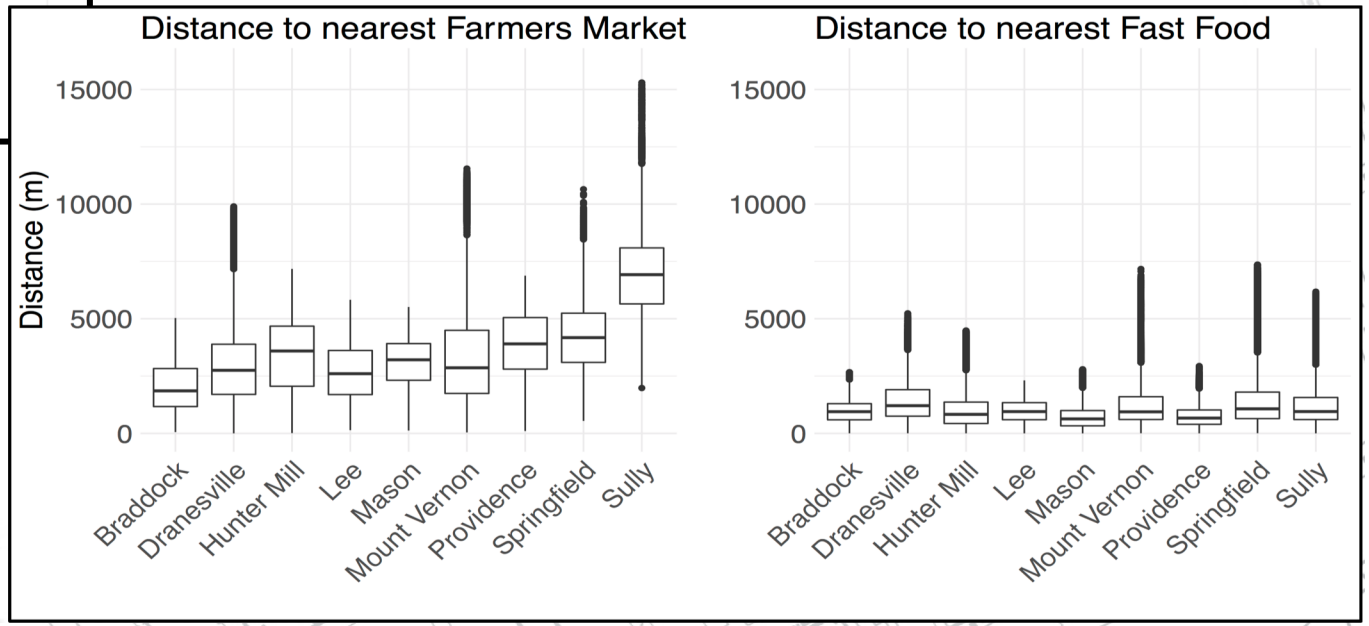


Direct aggregation based on location of housing units

Geocoding owner-occupied local housing stock

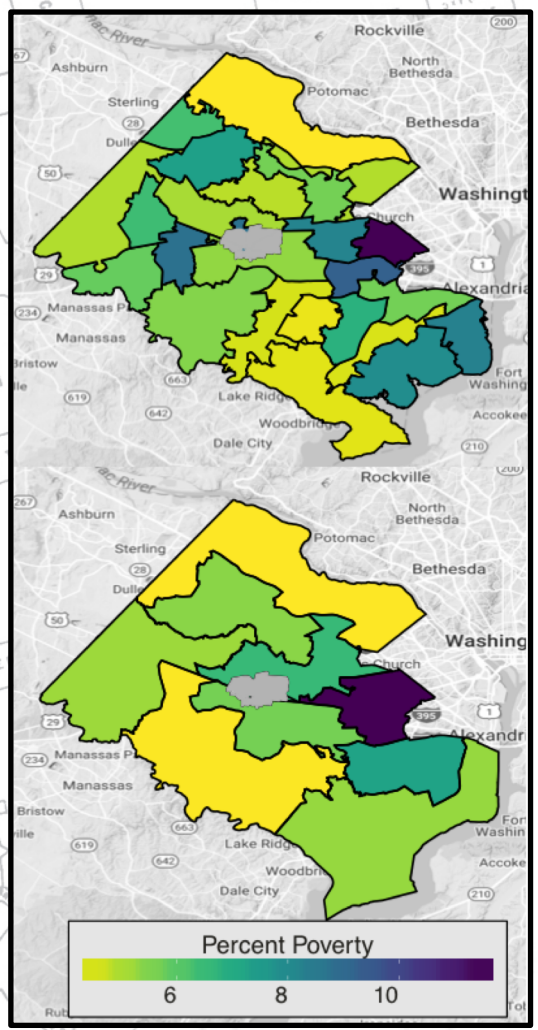
In general, adding rental units can be a challenge and may require imputation





Examples of **place data**:

- All restaurants
- Fast Food restaurants
- Farmer's Markets
- Community Gardens
- Recreation Centers
- SNAP Retailers
- Parks



Re-distribution of data based on Synthetic Information

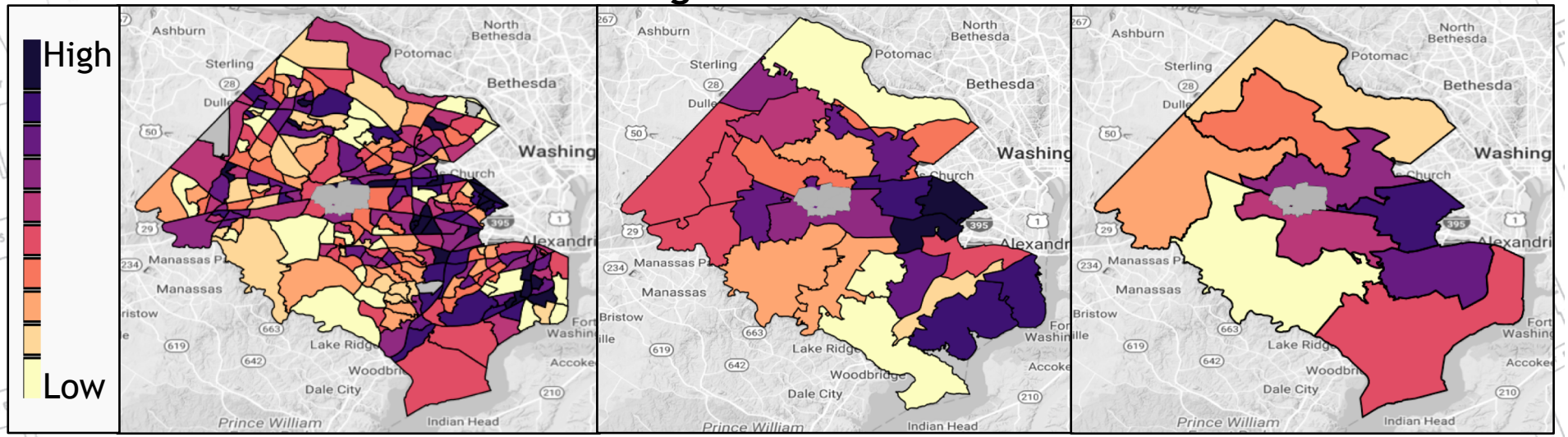
- Use American Community Survey (ACS) summaries and PUMS microdata to impute synthetic person data for all people in area of interest
- Re-weight synthetic data according to ACS tables to simultaneously match the relevant distributions, to Census Tracts or Block Groups
  - **Age, income, race, and poverty in this case**
- Aggregate synthetic person data to compute summaries, and margins of error, over the new geographic boundaries

Fairfax County Vulnerability Indicators

Census Tracts

High School Boundaries

Political Districts



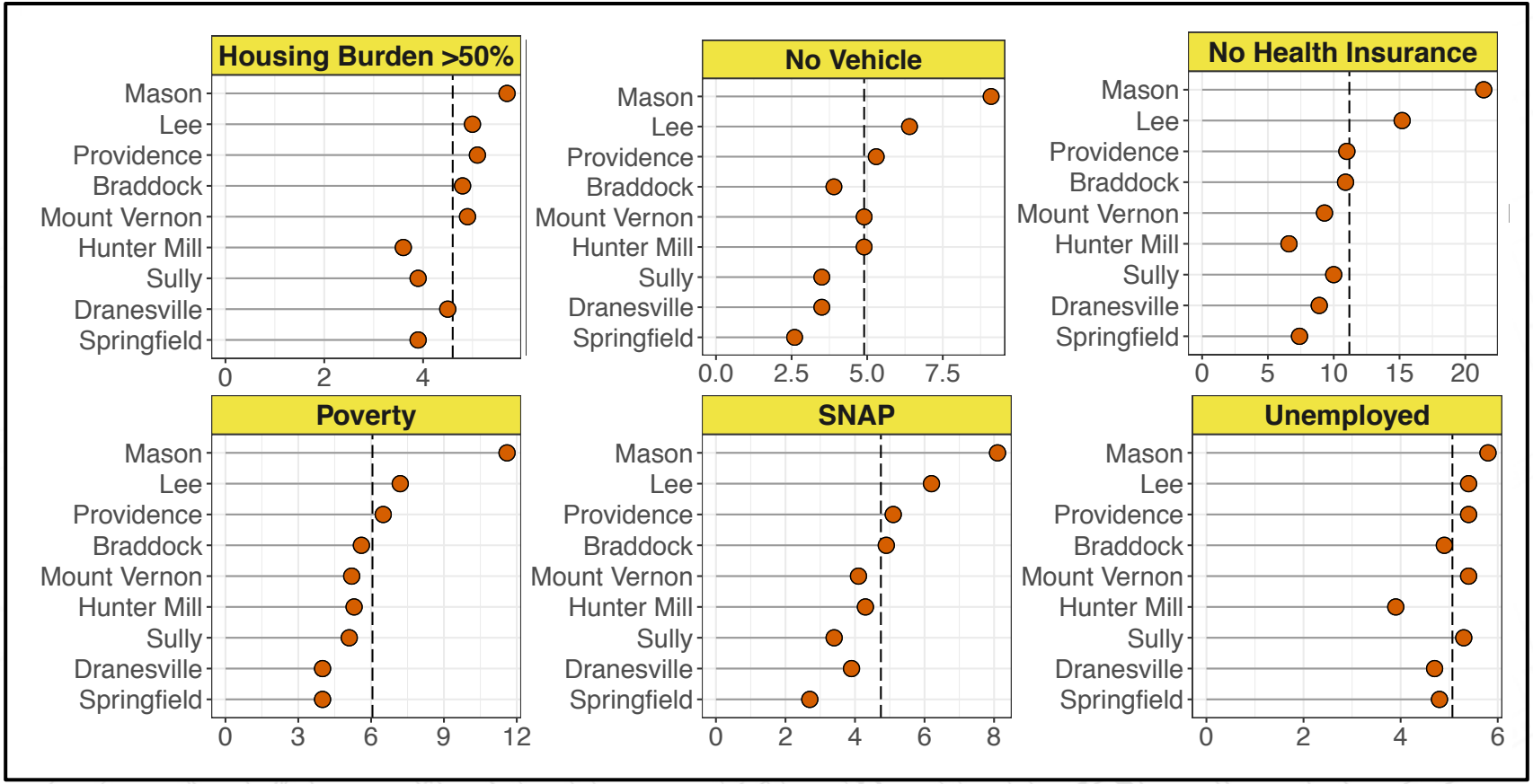
Statistical combination of percent of Households with:

- housing burdens > 50% of Household income
- no vehicle
- receiving Supplemental Nutrition Assistance Program (SNAP)
- in poverty

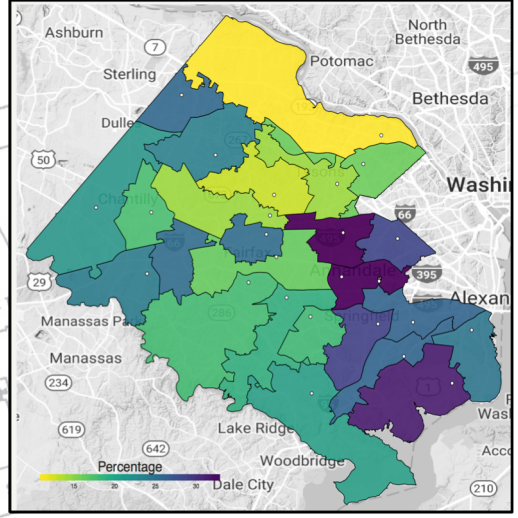
Source: American Community Survey 2011-2015 aligned to geographies using SDAL Synthetic Technology

Fairfax Profiles by Supervisor Districts

Dashed lines = Average; Supervisor Districts arranged by Vulnerability Index from high to low



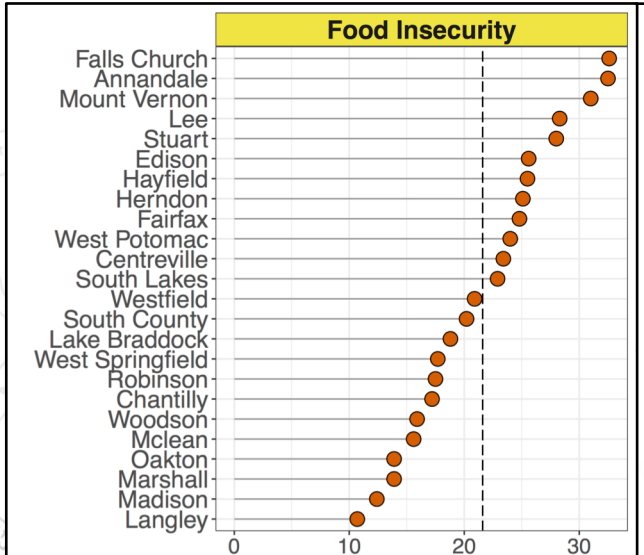
Source: American Community Survey 2011-2015 aligned to Supervisor Districts using SDAD Synthetic Technology

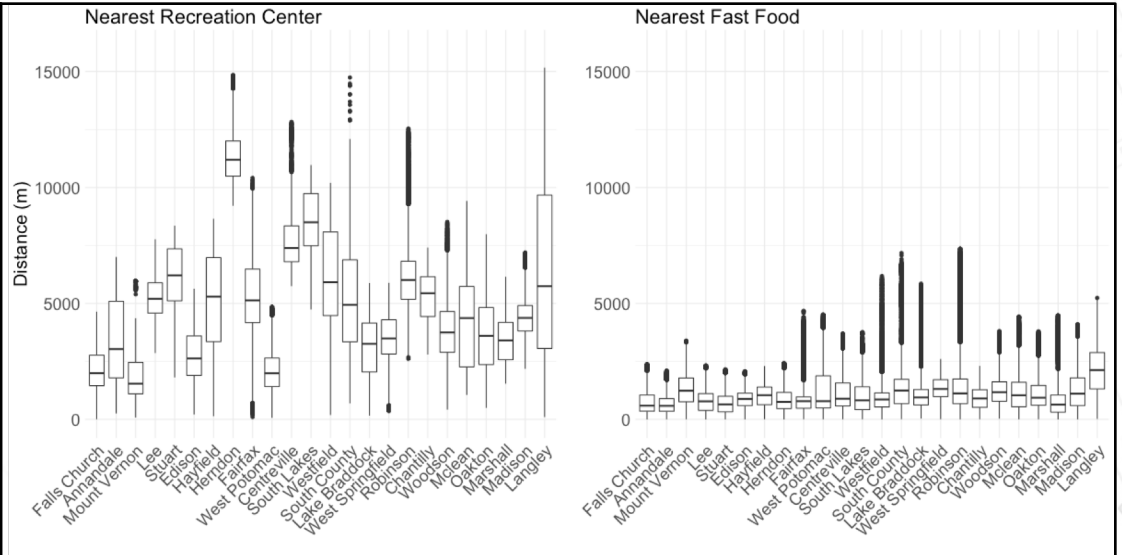


Fairfax County Youth Survey Food Insecurity

Some students in all school areas experience food insecurity every month

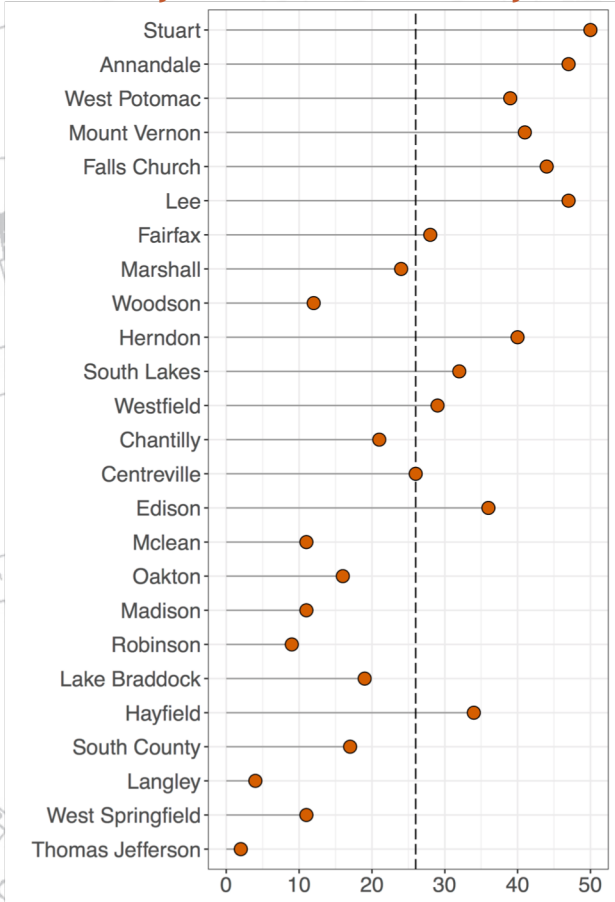
- 22% of all students in Fairfax County High Schools experience food insecurity (dashed line)



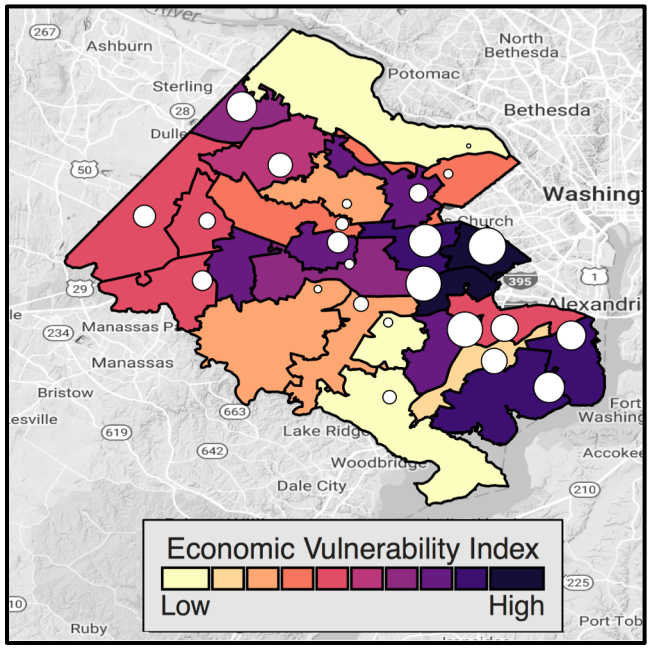


High School Vulnerability Indexes

High School Vulnerability Index
ordered by Economic Vulnerability Index



School Vulnerability Index

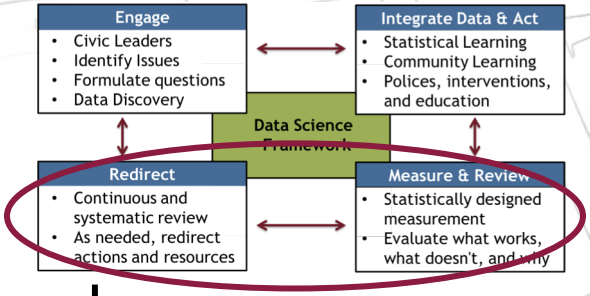


Combination of:

- Percentage of student in LEP classes
- Percentage of students that eligible for **one** of the following:
  - Free/Reduced Meals
  - Medicaid
  - Temporary Assistance for Needy Families
  - Migrant or experiencing Homelessness

Sources: ACS 2011-2015; NCES, CDC, and VDOE 2014-2015.

Fairfax County - next steps



- **Descriptive analytics** - Prepares and analyzes ***historical*** data and identifies patterns from samples for reporting of trends

- **Predictive analytics** - Predicts ***future*** probabilities and trends and finds relationships in data that may not be readily apparent with descriptive analysis

- **Prescriptive analytics** – Prepares models to conduct ***scenario analysis*** on future policy and program options

Operational realities - Could you briefly share when this project started, when you got data access, and when it was completed? And any other reflections on the operational opportunities or challenges related to using administrative data?

Timeline - overall about a year; actual research about 5-6 months

- Discussions in spring 2017
- Agreement in place by June 2017
- Kickoff in August 2017
- Data work and analysis from August – January 2018
- Briefings during the spring 2018

Data access

Used open data from FX and the web + ACS, federal surveys, place-based data scraped from web + **anonymized FX Co. Youth data, which we used for some preliminary modeling.**

Research provided increasing awareness about making other data available to researchers through DSAs and processes to ensure the security of the data. Our research group has these processes in place. The next step is to work with the county.

What do you think are the biggest challenges and opportunities for your profile in relation to data access (whether Agency data owners, Federal research who was not the data owner, an outside academic, or another type of profile)? How much did you have to modify your target question based on data access you had?

- Challenges have led to our innovations.
- Rarely have perfect data – in this case, missing key variable, BMI
- Data discovery is important step for us to identify data we ideally want. Provides us with a guide and helps identify gaps.
- Also has led us to develop synthetic technology processed to statistically integrate and aggregate data as well as to present data at different levels of geography than just CTs and CBs, such as political districts and school boundaries.
- **Data Ingestion and Governance part of our DSF - the profiling, cleaning, linking, and exploring the data - can take 80% of the time of the project. We are developing methods to automate and hence reduce this time – which will lead to reductions in the amount of time to do these activities and increase over time – and hence allow more time for analysis. This is a really important part of our work.**