A 21st Century Census Curated Data Enterprise:

Pilot Demonstration on Food Insecurity

Presentation to UVA Census CDE Team
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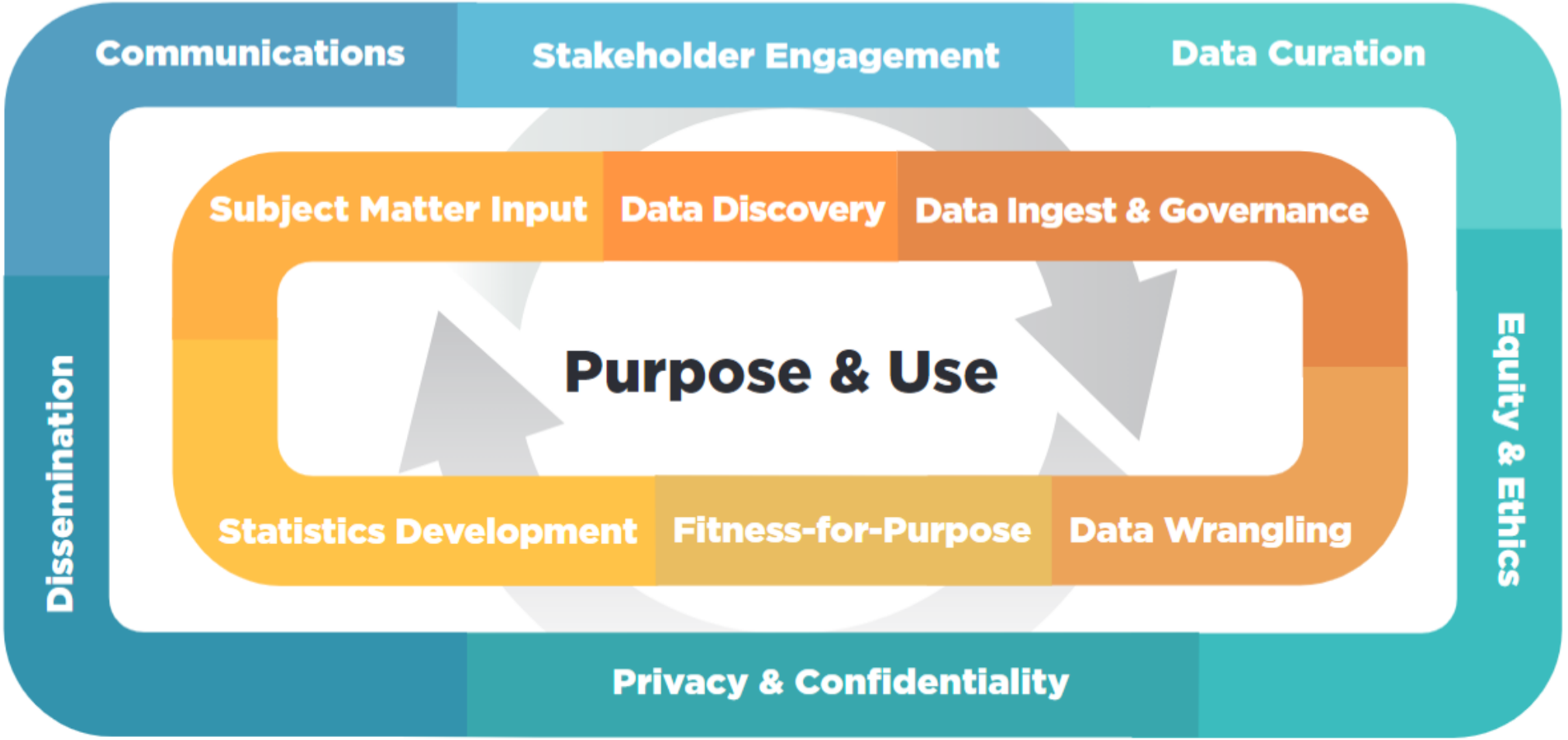
Curated Data Enterprise Framework

Goal: Illuminate the needed capabilities of the CDE to create a research agenda



Baseline Question

The USDA Current Population Survey Food Security Supplement (CPS-FSS) food insecurity measure is designed to monitor food insecurity over time at national and state levels.

If a food insecurity measure is to inform action and target interventions, it must be constructed for smaller geographic levels.

Can we construct a measure of food insecurity at the household level that can be aggregated up to the census tract?

Curated Data Enterprise Framework

Question

Can we construct a food insecurity measure at the census tract level?

Literature Review

What are the determinants of food insecurity?

Metric Ideas

Data Discovery

- Inventory
- Screening
- Acquisition
- Ingestion
- Governance
- Wrangling

Literature Review: Determinants of Food Insecurity

"Food insecurity is a multidimensional concept, experienced differently by different household types and population groups. While an overall measure of food insecurity, valid for the whole U.S. population, would be desirable, it is likely that such a measure would underestimate hunger and food insecurity for certain subgroups, especially for children and elderly adults. . . ***Food insecurity is a complex issue that may not be fully captured by a one-dimensional item response model, especially as it will be used to track food insecurity over time, across different surveys, and for different subpopulations****."*

(Opsomer et al., 2002, p 35)

Opsomer JD, Jensen HH, Nusser SM, Drignei D, & Amemiya Y. (2002). *Statistical considerations for the USDA food insecurity index*. https://dr.lib.iastate.edu/server/api/core/bitstreams/6e0682b1-9124-4c88-892a-31410fdeb6a1/content

Literature Review: Determinants of Food Insecurity

The empirical literature on the determinants of food insecurity can be grouped into two broad categories:

- the first is the **demographic and socioeconomic characteristics** of the food insecure (households (HHs) with children; single-parent HHs; large HHs; low income HHs; low levels of education; uneducated).
- the second consists of **expenditures on basic needs that compete with the amount of money available for food** (housing, utilities, transportation, taxes, health insurance, medical bills, transportation).

There is strong evidence that expenditures for basic needs should be adjusted for geographic cost-of-living (COL).

Literature Review: Determinants of Food Insecurity

D.C. has a 2021 regional price parity (RPP) value of 111.3, an indication that **prices in the District are 11.3% higher than the U.S. on average**. In contrast, Mississippi has a 2021 RPP value of 86.6, prices in the Mississippi are 13.4% lower than the U.S. on average.

Bureau of Economic Analysis (2021) Regional Price Parities:
https://www.bea.gov/news/2022/real-personal-consumption-expenditures-state-and-real-personal-income-state-and

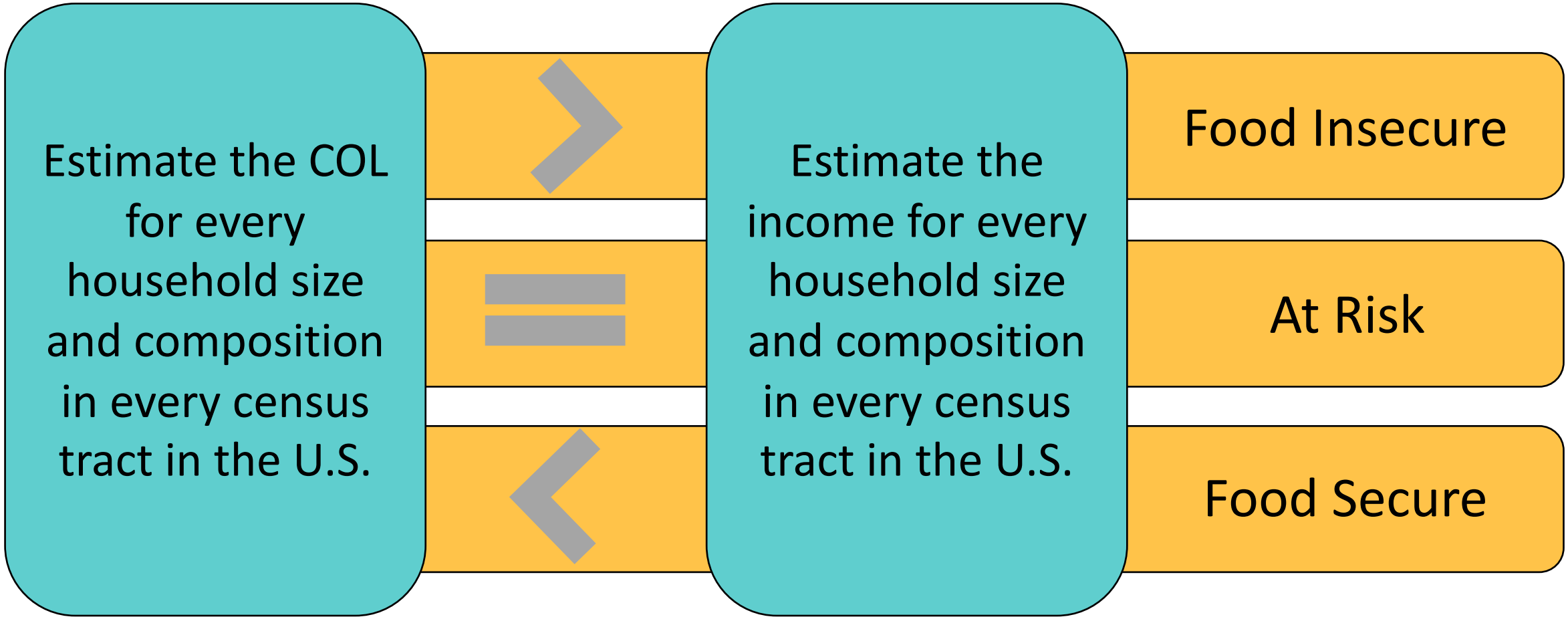
Todd et al. (2011) reported that most analyses of food prices report annual inflation over time at the national level, ignoring the fact that food price variation between geographic market groups within the U.S. is greater than annual inflation. They used the 2006 Quarterly Food-at-Home Price Database to show **the difference for eggs between the highest and lowest geographic market groups was 80 percent**, the difference for low-fat milk was 77 percent, and for fresh/frozen fruit 80 percent.

Todd JE, E Leibtag, and C Penberthy. (June 2011).
Geographic Differences in the Relative Price of Healthy Foods, EIB-78, **U.S. Department of Agriculture, Economic Research Service**
https://www.ers.usda.gov/webdocs/publications/44558/7476_eib78.pdf?v=0

"**Evidence of cost-of-living differences among geographic areas—such as between metropolitan and nonmetropolitan areas—suggests that the poverty thresholds should be adjusted accordingly**, but **inadequate data** make it difficult to determine appropriate adjustments."

National Research Council. (1995).
Measuring Poverty: A New Approach.
Washington, DC: The National Academies Press. https://doi.org/10.17226/4759

Food Insecurity Metric



Cost-of-Living Definition & Assumptions

Definition: COL estimates are based on the amount of income necessary to pay federal and state income taxes and meet a household's basic essential needs. The basic needs include housing, food, transportation, health insurance, childcare, broadband, and other necessities such as clothing and a phone. The COL is a function of family size and composition and where the family resides.

Assumptions: The full cost of each need, without government subsidies (e.g., public housing, Medicaid, or childcare assistance); or nonprofit or informal assistance from family and friends (e.g., unpaid childcare by a relative, food from food banks, or shared housing).

Living Wage Calculators

Monthly Cost
(2 adults both working / 2 children ages 4 & 9)

Living Wage Calculators	Albemarle County, VA	Washington DC	
Economic Policy Institute Family Budget Calculator	**$8,161** 2020	**$9,128** 2020	10 household size/composition combinations
Self-Sufficiency Standard — CENTER FOR WOMEN'S WELFARE, UNIVERSITY of WASHINGTON, School of Social Work	**$6,823** 2021	**$4,744** 2005	>600 household size/composition combinations
Living Wage | calculator — MIT	**$8,827** 2023	**$10,209** 2023	12 household size/composition combinations

Tools to help individuals, communities, and employers determine a local wage rate that allows residents to meet minimum standards of living.

The cost-of-living is used to backout the area minimum wage.

Why Household Size /Composition?

Household Size by PUMAs in Fairfax County, VA

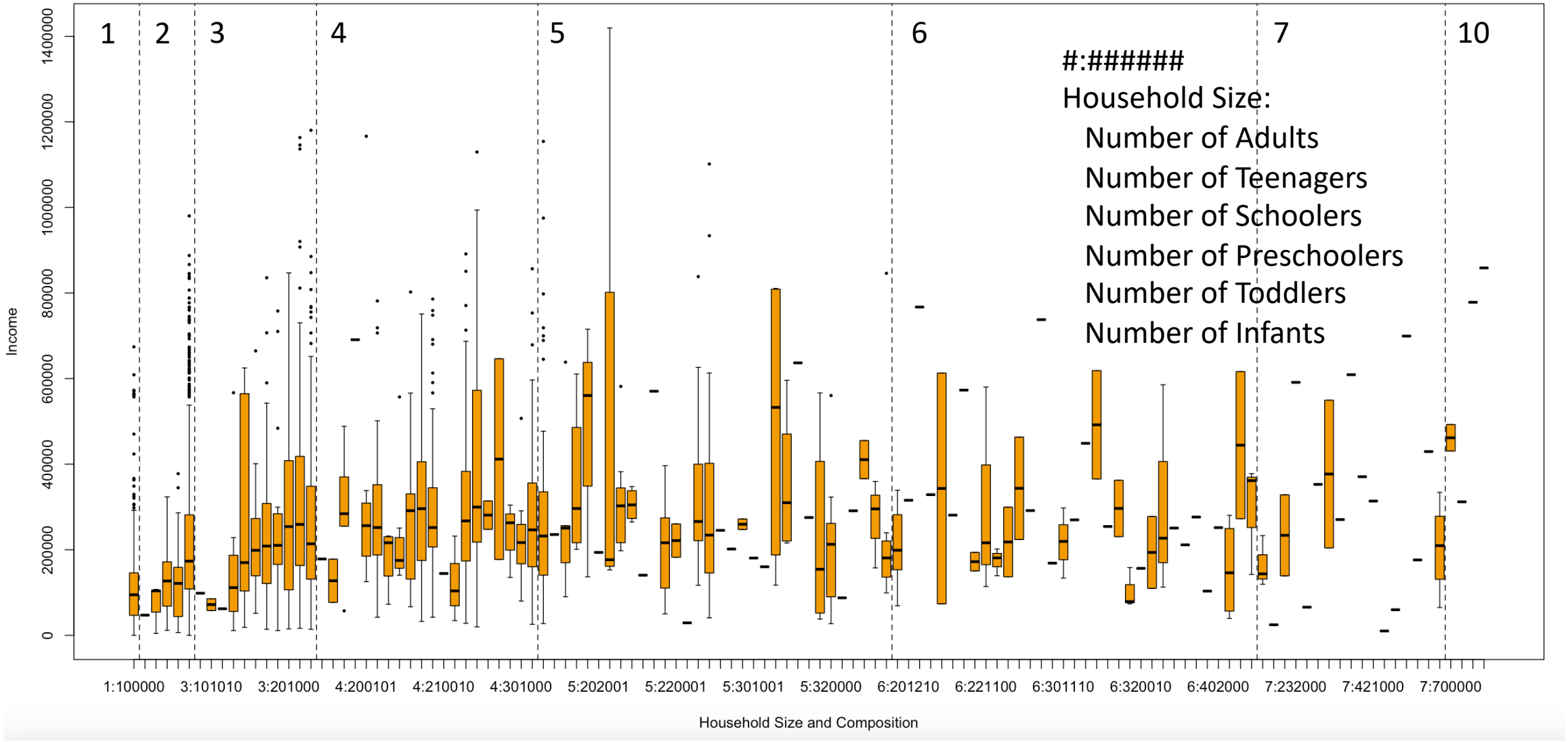
PUMA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
59301	710	932	434	351	175	71	27	12	3	1	1	0	1	0	0
59302	677	885	410	382	151	55	24	8	5	2	0	1	0	0	0
59303	541	1152	658	613	247	73	31	11	3	4	1	1	0	0	0
59304	301	615	382	369	136	54	22	7	2	0	0	0	0	0	0
59305	507	875	466	466	149	58	23	0	2	3	0	0	0	0	0
59306	507	657	366	317	129	54	11	7	7	2	0	1	0	0	0
59307	801	1164	618	573	170	63	18	10	3	1	2	0	0	1	0
59308	517	845	409	390	199	48	8	2	1	0	0	0	0	0	1
59309	412	601	361	355	141	39	11	6	1	2	1	0	0	1	0

Number of Different PUMA Household Compositions by Size

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	6	18	35	62	78	63	43	23	14	5	3	1	1	1

Why Household Size /Composition?

Fairfax Puma 59305: Household Income by 124 Household Size/Composition Combinations



COL Data Discovery Results

Component	Date	Data Source	Original Geographic Area	Geographic Area Adjustment	Inflation (Time) Adjustment	Final Geographic Area
Housing	2023	HUD Small Area 40% of Fair Market Rent (produced yearly for 5 apartment sizes: studio, 1, 2, 3, and 4 bedrooms)	ZIP code	ZIPS codes are distributed to census tracts based on demographic data	NA	Census tract
Food	2022 DEC	USDA Low-Cost Food Plan: Average Cost of Food at Home (produced monthly for different 15 age/gender levels categories: Child 1, 1-3, 4-5, 6-8, 9-11; Female 12-13, 14-18, 19-50, 51-70, 71+; Male 12-13, 14-18, 19-50, 51-70, 71+)	National	National adjusted to the county level using 2020 Feeding America's Map the Meal Gap estimates at the county and independent city level	Consumer Price Index, Washington-Arlington-Alexandria area – November 2022; Consumer Price Index, Washington-Arlington-Alexandria area – November 2021 (used to adjust the 2020 Feeding America's Map the Meal Gap data)	County

Assumptions:
- 1-person in a studio
- 2-people in a 1 bedroom
- 3-people in a 2 bedroom
- ≥4-people in a 3 bedroom

Assumptions:
- half the people in a household are female and half are male
- infants < 1
- toddlers 1-3
- preschoolers 4-5
- schoolers 6-11
- teenagers 12-18
- adults ≥19

COL Data Discovery Results

Component	Date	Data Source	Original Geographic Area	Geographic Area Adjustment	Inflation (Time) Adjustment	Final Geographic Area
Transportation	2022	H+T non-profit Center for Neighborhood Technology (Methodology)	Census tract	NA	NA	Census tract
Healthcare	2023	U.S. Centers for Medicare & Medicaid Services, Health Insurance Market Place (produced yearly for categories: household size/composition/age/income)	ZIP code	NA	NA	County
Childcare	2022	Department of Labor Women's Bureau National Database of Median Childcare Prices (yearly price for 8 daycare type/age categories: center and home based for infant, toddler, preschool, school-age) (Methodology)	County	NA	Department of Labor Women's Bureau National Methodology used to impute the Washington, D.C. child care area cost from 2012 to 2022	County

Assumptions:
- includes auto ownership, auto use, and transit use
- independent of family size and composition

Assumptions:
- households purchase health insurance through the Affordable Care Act Market Place

Assumptions:
- parents use home-based care
- children > 12 (teenagers) do not require childcare
- infants < 1
- toddlers 1-3
- preschoolers 4-5
- school-age 6-18

COL Data Discovery Results

Component	Date	Data Source	Original Geographic Area	Geographic Area Adjustment	Inflation (Time) Adjustment	Final Geographic Area
Broadband	2023	Scraped from BroadbandNow Median of the lowest prices for 100 Mbps download plans for addresses from the Department of Transportation, National Address Database	Address at the center of a Census block	NA	NA	Census tract
Other Necessities	NA	10%	NA	NA	NA	NA
Taxes	2022	National Bureau of Economic Research's program TAXSIM Version 35 which has an interface in R usincometaxes (yearly for IPUMS categories: household size/composition/age of children/income)	State	NA	NA	State

Assumptions:
- every household has a download plan with a minimum of 100 Mbps

Assumptions:
- work in progress

Assumptions:
- all households are renters therefore pay no property taxes
- tax liability includes income and sales taxes at the federal and state levels
- there are no household deductions

Our original idea was to use Iterative Proportional Fitting using the marginals from the ACS.

We think we can do better with a new methodology and using PUMA data.

Food Insecurity Status

Food + Housing + Healthcare + Childcare + Transport + Taxes + Other

USDA and Feeding America · Dept. Housing Urban Develoopm. · Health Insurance Marketplace · Women's Bureau US Dept. of Labor · Center for Neighborhood Technology · IPUMS and NBER · US Bureau of Labor Statistics

↓

Cost-of-Living

⇓

Food Budget covers **Food** → Food Secure
Food Budget does not cover **Food** → Food Insecure
Food Budget may cover **Food** → At-Risk

Iterative Proportional Fitting

Income bracket	1	2	3	4	5	6	7	Number Households
Less than $10,000								9
$10,000 to $14,999								9
$15,000 to $19,999								9
$20,000 to $24,999								17
$25,000 to $29,999								40
$30,000 to $34,999								10
$35,000 to $39,999								7
$40,000 to $44,999								10
$45,000 to $49,999								0
$50,000 to $59,999								36
$60,000 to $74,999								80
$75,000 to $99,999								93
$100,000 to $124,999								188
$125,000 to $149,999								56
$150,000 to $199,999								87
$200,000 or more								445
Total:	146	398	197	229	82	10	34	1,096

Estimated number of households

Food Insecurity Categories

Income bracket	1	2	3	4	5	6	7	Number Households
Less than $10,000								9
$10,000 to $14,999								9
$15,000 to $19,999								9
$20,000 to $24,999								17
$25,000 to $29,999								40
$30,000 to $34,999								10
$35,000 to $39,999								7
$40,000 to $44,999								10
$45,000 to $49,999								0
$50,000 to $59,999								36
$60,000 to $74,999								80
$75,000 to $99,999								93
$100,000 to $124,999								188
$125,000 to $149,999								56
$150,000 to $199,999								87
$200,000 or more								445
Total:	146	398	197	229	82	10	34	1,096

Food Insecure Households

At-Risk Households

Food Secure Households

Next Steps

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION
2022, VOL. 00, NO. 0, 1–13: Theory and Methods
https://doi.org/10.1080/01621459.2022.2104728

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Check for updates

Nonparametric Estimation of Repeated Densities with Heterogeneous Sample Sizes

Jiaming Qiu, Xiongtao Dai*, and Zhengyuan Zhu

Department of Statistics, Iowa State University, Ames, IA

- The idea is to estimate a distribution of incomes for every household size and composition for every census tract by using household data at the census tract level from the ACS along with the household income and composition for the PUMA.
- Provide three estimates at the census tract level, food secure, food insecure, and at-risk of food insecurity along with a MOE.