

Method for Estimating Chicago Community Area Population

In order to estimate the child population in Chicago at the community area level, the 1980, 1990, 2000, and 2010 Decennial Censuses were used and population estimates for five-year age groupings were interpolated for intercensal years using a cubic spline method. The resulting estimates for Chicago Community Areas (CCAs) and suburban Cook County were adjusted to sum to the Census Bureau’s intercensal estimates for Cook County. These estimates were then used to forecast population five-year age groups within CCAs for years beyond the 2010 Census using a simple damped-trend exponential smoothing model. The resulting forecasts through 2015 were then interpolated within age groupings to produce single year of age estimates using the Sprague multipliers, allowing regrouping of the final forecasts into the 0-5 age group.

Method for Estimating Child Poverty Counts by Age, Community Area, and Calendar Year

The number of young children who are under the poverty line each year in CCAs must be estimated because there is no reliable single source of information on small area poverty rates since the decennial census no longer reports poverty rates at fine-grained geographic levels.¹ This section explains the method used to combine multiple data sets to estimate these counts.

The estimation strategy uses administrative data from the Illinois Department of Human Services (DHS) on young children receiving the Supplemental Nutrition Assistance Program (SNAP) benefits (commonly referred to as “food stamps”),² and the Integrated Public Use Microdata Series (IPUMS) release of American Community Survey (ACS) data. Administrative SNAP data has detailed information about the location of young children in terms of time and place, but does not quite have the right information—i.e., poverty status—about these children. By contrast, ACS microdata lack information about specific geographic location of families, but have information by year, and about whether families have young children, whether they take up SNAP, and what their poverty status is. We derive our basic estimates by combining the complementary features of these data sets.

The equation below summarizes the calculation used in the estimation process. The first term on the right-hand side is obtained from DHS administrative data on SNAP recipients. The second term on the right-hand side is obtained from ACS IPUMS data.

$$\begin{aligned} & \left(\begin{array}{l} \textit{Estimated Number of Children in} \\ \textit{Poverty in Year Y, in CCA } c \end{array} \right) \\ &= \left(\begin{array}{l} \textit{Number of Children in Cases Taking} \\ \textit{up SNAP in Year Y, in CCA } c \end{array} \right) \\ &\times \left(\begin{array}{l} \textit{Number of Children in Households Under} \\ \textit{the Poverty Line in Year Y in Chicago} \\ \hline \textit{Number of Children in Households Taking Up} \\ \textit{SNAP in Year Y in Chicago} \end{array} \right) \end{aligned}$$

¹ ACS 5-year data provide information about poverty rates of individuals of different ages.

² Note that SNAP eligibility is set at 130% of the Federal Poverty Line for households without disabled or elderly individuals (see <http://www.dhs.state.il.us/page.aspx?item=30357>).

This estimate was calculated for each calendar year from 2005 to 2014, which are respectively the first year that the ACS IPUMS data were released and the most recently available release at the time of these calculations. These estimates were calculated separately for children from ages 0 to 2 and ages 3 to 5.

A first-order autoregressive time series model³ was used to extrapolate poverty counts to calendar year 2015. The time series for each CCA were first normalized relative to the CCA's mean across the 2005-2014 period, to make it possible to compare the shape of population trends for CCAs with both large and small populations in poverty. These rescaled time series were then pooled in the autoregressive analysis to estimate a (1) common persistence term and (2) CCA-idiosyncratic linear time series (i.e., both intercept and slope with respect to time). Extrapolations were then made to 2015 using the normalized time series, which were then normalized back to their original population levels by multiplying each CCA's normalized values with its 2005-2014 mean population size.

In rare cases, community areas had a projected number of children in households earning more than 200% of the Federal Poverty Line (FPL) that exceeded the total population. In these cases, the estimated number of children at all levels of poverty below 200% FPL—including below the poverty line—were proportionally decreased by the ratio of the <200% FPL estimate to the overall population estimate.

Method for Estimating Children Poverty Counts by Race/Ethnicity

Estimated poverty counts by race/ethnicity were obtained by using ACS 5-year data to divide the tract-by-year estimates of child poverty counts described above.⁴ This source has data on total counts and counts by demographic characteristics of children under 5 years old, under the poverty line, by tract, and for the time period 2010-2014.^{5,6}

These ACS 5-year aggregate tables are reported separately for different race (e.g., “white”, “black”, “Asian” households) and ethnicity categories (notably “Hispanic” and “non-Hispanic”), where double-counting is possible (e.g., in cases where individuals who are “Hispanic white” are represented in both the “white” and “Hispanic” table counts). The Census report “Overview of Race and Hispanic Origin: 2010”⁷ was used to reapportion the ACS 5-year poverty percentage by race/ethnicity combination, by estimating, for example, what percentage of whites are Hispanic to construct estimates of “Non-Hispanic white”, etc.

³ See “Time Series: Theory and Methods” by Peter J. Brockwell and Richard A. Davis for a discussion of this type of model and its use.

⁴ Note that this ACS data source is different from the IPUMS data used to produce the estimates above. The IPUMS data have detail at the single-year status for both SNAP receipt and poverty status, but only produce reliable statistics at the city level. The smallest reporting unit for the IPUMS data is the Public Use Microdata Area (PUMA), which contain at least 100,000 people (see <https://www.census.gov/geo/reference/puma.html>). While there are 19 PUMAs in Chicago, many PUMAs have very small numbers of sampled children who are both in poverty and in the age range we consider. By contrast, the ACS 5-year aggregate data have less temporal resolution, but has geographic detail down to the census tract level. The latter data source is used in this exercise because the racial/ethnic breakdown of children in poverty was believe to be more stable across time than it was across geographic areas.

⁵ See tables “B17001A” through “B17001I”, which correspond to “Poverty status in the past 12 months by sex by age” for a range of race and ethnic demographics.

⁶ Note that these estimates were not used for the primary exercise of identifying poverty counts at the tract level, because they are only available at 5-year aggregations, which hampers the ability to identify time trends.

⁷ See <http://www.census.gov/prod/cen2010/briefs/c2010br-02.pdf>.

These adjusted ACS 5-year, CCA-level estimates of percentage of children in poverty were applied to the total community area-by-year estimates described in the above section, after the projections and any necessary adjustments were made.⁸

This calculation is represented in the equation below.

$$\begin{aligned} & \left(\begin{array}{l} \text{Estimated Number of Demographic } D \text{ Children} \\ \text{in Poverty in Year } Y, \text{ in CCA } C \end{array} \right) \\ &= \left(\begin{array}{l} \text{Percent of Children in Demographic } D, \text{ in} \\ \text{CCA } C \text{ from ACS 2010 – 2014 data} \end{array} \right) \\ &\times \left(\begin{array}{l} \text{Estimated Number of Children in} \\ \text{Poverty in Year } Y, \text{ in CCA } C \end{array} \right) \end{aligned}$$

An adjustment was made to these estimates to account for the fact that some tracts had either too few children in poverty or too few children of a given race/ethnicity for the ACS 5-year race/ethnicity breakdown data to be reliable. In these cases, the above “ACS 5-year” estimates were blended with a second set of “proportional” estimates produced by assuming that, within each community area, the percentage of children in a given race/ethnicity who were in poverty would be equal to the percentage of children of that race/ethnicity in the overall population. The “blending” calculation was:

$$\begin{aligned} \text{blended estimate} &= w * (\text{proportional estimate}) + (1 - w) * (\text{ACS 5 year estimate}) \\ w &= \max\left(\frac{200 - \sqrt{\text{pop}_{cd}}}{200}, 0\right) \end{aligned}$$

where pop_{cd} represents the overall population of children in CCA c and demographic d . When pop_d is close to zero, the blending weight w is close to 1, and the blended estimate is based mostly on the proportional estimate. The larger the value of pop_{cd} , the closer that blending weight w gets to zero, such that the blended estimate is based increasingly on the ACS 5-year estimate. When pop_d is larger than 200, the blending weight is exactly 0, reflecting our judgment that the ACS 5-year estimate is quite stable and needs no blending with the proportional estimate. The choice of the square root function indicated that the weight shifted more rapidly towards the “ACS 5-year” estimate as pop_d increased than it would if it were a linear function.

As the resulting blended estimates by demographic characteristics are a combination of disparate estimation methods, they are not guaranteed to sum to the overall estimated number of children in poverty. In cases of community areas-by-year where the sum of blended estimates was off, each of the blended estimates-by-race was adjusted by an amount equal to the ratio of poverty rate to blended sum, to ensure that the sum of the final estimates would equal the overall total.

⁸ This operation implicitly assumes that these proportions for children in poverty—for children under age 5, and for years 2010-2014—are applicable to children under age 6, and for each of the individual calendar years 2005 through 2014.