Methodology for the Intercensal Population and Housing Unit Estimates: 2010 to 2020
November 2024

Introduction

The Population Estimates Program at the U.S. Census Bureau produced the intercensal estimates for 2010-2020 for the United States and Puerto Rico populations and U.S. housing units by modifying the 2010-2020 postcensal estimates prepared previously for the United States and Puerto Rico, to account for differences between the postcensal estimates for April 1, 2020 and the 2020 Census counts.[1] The postcensal population estimates for 2010-2020 were produced by updating the resident population enumerated in the 2010 Census by the estimates of the components of population change between April 1, 2010 and April 1, 2020. The components include births to U.S. resident women, deaths to U.S. residents, domestic migration, international migration, and net movement of the U.S. Armed Forces. The postcensal housing unit estimates for 2010-2020 were produced by updating the number of housing units in the 2010 Census by adding new housing units and removing housing units that no longer existed.

The intercensal estimates reconcile the postcensal estimates with the 2020 Census counts and provide a consistent time series of population estimates that reflect the most recent census results. This makes them useful as denominators for calculating historical trends in birth and death rates, for projecting future populations, for calculating incidence rates for cancer and other diseases, and for tracking changes in other population characteristics, among numerous other applications.

Intercensal population estimates are available for the nation, states, metropolitan and micropolitan statistical areas, counties, incorporated places and minor civil divisions, and Puerto Rico and its municipios. In addition, housing unit estimates are available for the nation, states and counties. This initial set of intercensal estimates files features total intercensal estimates at all levels of geography and for both population and housing units. Files featuring full demographic detail (age, sex, race, and Hispanic origin) are in progress and will be released as soon as possible. This document outlines the methods used to produce the 2010-2020 intercensal estimates for the total resident population and for housing units.

Methodology

There is no universal norm for producing intercensal estimates. The Census Bureau historically has used a method to produce intercensal estimates that distributes the error of closure (EOC), defined as the difference between the census count and the estimate value on April 1, 2020, exponentially across the time series.[2] This approach is well suited where the EOC is relatively small compared to the census value. However, as the EOC grows, an exponential redistribution causes the patterns of change of the vintage estimates to become distorted, sagging in the middle when the EOC is positive and bowing in the middle when it is negative. To minimize these distortions, we have updated the method for producing the intercensals this decade to distribute the EOC linearly across

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[1] Throughout this work, the value used for April 1, 2010 reflects changes to the 2010 Census population from the Count Question Resolution program and geographic program revisions.
[2] This method was one of six alternatives outlined in a memorandum by Prithwis Das Gupta in the early 1980s, and heretofore referred to by the Population Estimates Program as the "Das Gupta method." For more information on this memo, please contact pop.cdob@census.gov.

the time series. This approach maximizes the degree to which the patterns of change in the vintage estimates are preserved in the intercensal estimates.

Equation 1: $P_t = Q_t + (t - t_0) * \frac{(P_{3653} - Q_{3653})}{(t_{3653} - t_0)}$

Where   t = time in days elapsed since April 1, 2010
P_t = Intercensal estimate at time t
Q_t = postcensal estimate at time t
P_{3653} = April 1, 2020 census count
Q_{3653} = April 1, 2020 postcensal estimate based on the 2010 Census

We used the above method for all intercensal population and housing unit estimates. However, adjusting a time series of small estimates that vary dramatically across the time series can often result in negative estimates. We handled these situations by recalculating their time series as linear interpolations between the Vintage 2020 base value for April 1, 2010 and the 2020 Census value. The next section describes the process of producing the estimates in more detail.

Detailed Methodology

Estimates for the group quarters (GQ) and household populations were produced independently, and the results were combined to create the resident population. "Annual estimates" refer to estimates for July 1.

National

1. Monthly estimates were produced by distributing the EOC linearly across the time series (see Equation 1 above) and rounding to the nearest whole number.
2. Monthly estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to the monthly totals from step 1.

State

1. Annual estimates were produced by distributing the EOC linearly across the time series and controlling to the national annual values.
2. Annual estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to both the state totals and the national GQ/household totals.

County

1. Annual estimates were produced by distributing the EOC linearly across the time series and controlling to the state annual values.
2. Annual estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to both the county totals and the state GQ/household totals.

<u>Subcounty</u>

1. The geographies of the Vintage 2020 estimates and the 2020 Census were reconciled before the intercensal estimates were produced.[3]
2. Annual estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to the county GQ/household totals.

<u>Puerto Rico Commonwealth</u>

1. Annual estimates were produced by distributing the EOC linearly across the time series and rounding to the nearest whole number.
2. Annual estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to the annual totals.

<u>Puerto Rico Municipios</u>

1. Annual estimates were produced by distributing the EOC linearly across the time series and controlling to the commonwealth annual values.
2. Annual estimates for the GQ and household populations were produced by distributing the EOC linearly across the time series and controlling to both the municipio totals and the commonwealth GQ/household totals.

<u>Housing Units</u>

1. As noted for the subcounty population estimates above, the Vintage 2020 and 2020 Census files were geographically reconciled to create matching files.
2. National, annual estimates were produced by distributing the EOC linearly across the time series and rounding to the nearest whole number.
3. State-level, annual estimates were produced by distributing the EOC linearly across the time series and controlling to the national annual values.
4. County-level, annual estimates were produced by distributing the EOC linearly across the time series and controlling to the state annual values.
5. Primitive-level, annual estimates were produced by distributing the EOC linearly across the time series and controlling to the county annual values.[4] These estimates were summed to the subcounty estimates for incorporated places and minor civil divisions.

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[3] The reconciliation process corrected for both new and deleted entities in both the vintage estimates and the census. The vast majority of adjustments were made to bring the vintage estimates in line with the census geographies; however, some differences could only be addressed by adjusting the census geographies. This process did not address annexation differences, so there may be cases where annexations captured in the estimates are not reflected in the census and vice versa. This situation will manifest as larger-than-usual EOCs; however, not all large EOCs are due to annexation inconsistencies.
[4] *Primitive geographies* are a complete, mutually exclusive partition of the United States which can thus be aggregated into all geographic units for which the Population Estimates Program produces estimates.