

Methodology for the State and County Total Resident Population Estimates (Vintage 2007): April 1, 2000 to July 1, 2007

NOTE: These estimates include adjustments due to the effects of hurricanes Katrina and Rita. For a description of these adjustments, refer to the Special Processing Procedures for the Areas Affected by Hurricanes Katrina and Rita at <http://www.census.gov/popest/topics/methodology/>.

The U.S. Census Bureau annually produces estimates of total resident population for each state and county using a component of population change method at the county level. To produce the state population estimates, we simply sum all county populations within each state. The following documentation describes the process by which we produce the July 1, 2007 total resident population estimates at the county level.

Overview

The Census Bureau develops county population estimates with a component of population change method in which we use administrative records to estimate the household and group quarters population. For the household population, the components of population change are births, deaths, net domestic migration, net international migration, and net overseas military movement. We measure change in the non-household, or group quarters, population by the net change in the population living in group quarters facilities.

A major assumption underlying this approach is that changes in selected administrative or survey data sources closely approximate the components of population change. Therefore, Census Bureau demographers separately estimate each component of population change based on administrative records, including registered births and deaths, Federal income tax returns, Medicare enrollees, and military movement. We also incorporate data from the American Community Survey into the estimates.

Most administrative record data sources lag the current estimate year by as much as two years, therefore, we project the data for the current year based on past years' data. As updated data become available, we revise the past year's estimates so that the current estimates are always based on the most recent data available.

We produce the estimate of each county's population, starting with the base population from either Census 2000 (for the July 1, 2000 estimates) or the revised population estimate for the most recent year (for the July 1 estimates of all years after 2000). We then add or subtract the demographic components of population change calculated for that time period. Basically, we add the estimated number of births and subtract the estimated number of deaths for the time period. Next, we add (or subtract, as appropriate) the estimates of net domestic migration, net foreign-born international migration, net movement to/from Puerto Rico, net overseas Armed Forces movement, net native migration to/from the United States, and the change in group quarters population.

We produce separate population estimates for the populations under age 65 and aged 65 and older, mainly because different data are used to measure the domestic migration of these two populations. For the population under age 65, we use person-level data from individual Federal tax returns to estimate net domestic migration. We use Medicare enrollment data to calculate measures of migration for the population aged 65 and older because this population is not always well represented on tax returns.

Note: All of the calculations described below are done at the county (or county-equivalent) level unless otherwise indicated.

Method

Estimating the Population Under Age 65

Base Populations

To begin the process of producing population estimates under age 65, we prepare several base populations for each county: the base resident population under age 65, the base group quarters population under age 65, the base household population under age 65, and the population base of potential domestic migrants under age 65.

The base resident population for the estimate of the population under age 65 is the revised resident population estimate for the prior estimate year or, in the case of the July 1, 2000 estimates, the Census 2000 base population. The revised population estimate for the prior year incorporates all revisions to input data and an updated Census 2000 base population that reflects Count Question Resolution corrections and geographic program revisions.

The group quarters population component consists primarily of military personnel living in barracks, college students living in dormitories, persons residing in institutions, inmates of correctional facilities, and persons in long-term health care facilities. We produce the base group quarters population under age 65 by excluding persons aged 65 and older that reside in nursing homes and other facilities.

We subtract the base group quarters population under age 65 and the resident population turning 65 during the estimate interval from the base resident population under age 65 to produce the base household population under age 65 by county. The general formula is as follows:

$$U65HP_{x-1} = AREST_{x-1} - (EX64_{x-1} + EPO65_{x-1} + GQ<65_{x-1})$$

Where:

- x = current estimate year
- U65HP = base household population under age 65
- AREST = total resident population for all ages
- EX64 = population age 64 in the previous estimate year (who will turn age 65 in the current estimate year)
- EPO65 = resident population aged 65 and older

GQ<65 = group quarters population under age 65

The population base of potential domestic migrants under age 65 should include all people who have the possibility of moving within the United States during the estimate period. The population at the beginning of the estimate period includes those people who died or moved out of the county during the period, but excludes people who were born or moved into the county during the period. The population at the end of the estimate period is just the opposite. Since neither population is an accurate depiction of the population at risk of moving into or out of the county during the estimate period, an appropriate compromise is to use the population at the midpoint of the period in our calculation of the population base of potential domestic migrants under age 65.

We assume that estimated resident births, estimated deaths, and net international migration are evenly distributed throughout the estimate period. Therefore, people experiencing these events are at risk of migrating, on average, for one-half of the period. We develop the domestic migration population base under age 65 by adding one half of the following to the previous year's household base population under 65 years: resident births minus resident deaths, plus net international migration. We calculate the domestic migration population base under age 65 using the following formula:

$$MBASE<65_x = U65HP_{x-1} + (.5 * (PB_x - PD<65_x + FBINAT<65_x - EMIG<65_x + NMPR<65_x))$$

Where:

- x = current estimate year
- MBASE<65 = population base of potential domestic migrants under age 65
- U65HP = base household population under age 65
- PB = period births
- PD<65 = period deaths to the population under age 65
- FBINAT<65 = net foreign-born international migration of the population under age 65
- EMIG<65 = native emigration of the population under age 65
- NMPR<65 = net movement to/from Puerto Rico under age 65

Components of Population Change

The components of population change that we use to produce county-level estimates are births, deaths, net domestic migration, net international migration, net overseas movement of the Armed Forces population, and net change in the group quarters population.

Births and Deaths: We use birth and death data from two sources: the Federal-State Cooperative Program for Population Estimates (FSCPE) and the National Center for Health Statistics (NCHS). Both the FSCPE and NCHS record resident births by the residence of mother, regardless of where the birth occurred. Similarly, we use death data that are tabulated by the residence of the decedent, not by the place where the death occurred, to represent deaths to the population under age 65.

Net Domestic Migration: We use data from Federal income tax returns supplied by the Internal Revenue Service (IRS) to measure the domestic migration of the household population under age 65. These data are limited to filers and their dependents that are under age 65. We derive net domestic migration rates using these data and then apply these rates to the domestic migration population base under age 65.

We calculate the net domestic migration rate for the household population under age 65 for each county using the following formula, which is based on the difference between the in-migration and out-migration of tax filers and their dependents.

$$\text{NiMR}<65_x = \frac{[(\text{INST}<65_x + \text{INCTY}<65_x) - (\text{OUTST}<65_x + \text{OUTCTY}<65_x)]}{(\text{NON}<65_x + \text{OUTST}<65_x + \text{OUTCTY}<65_x)}$$

Where:

- x = current estimate year
- NiMR<65 = net domestic migration rate for the household population under age 65
- INST<65 = in-migrants under age 65 from another state
- INCTY<65 = in-migrants under age 65 from another county within the same state
- OUTST<65 = out-migrants under age 65 to another state
- OUTCTY<65 = out-migrants under age 65 to another county within the same state
- NON<65 = nonmigrants under age 65

Once we have calculated the net migration rate, we apply that rate to the domestic migration population base under age 65. We subtract the county net Armed Forces movement of the population under age 65 to produce the number of county net domestic migrants using the following formula:

$$\text{MIG}<65_x = (\text{MBASE}<65_x * \text{NiMR}<65_x) - \text{AF}<65_x$$

Where:

- x = current estimate year
- MIG<65 = net domestic migration of the household population under age 65
- MBASE<65 = population base of potential domestic migrants under age 65
- NiMR<65 = net domestic migration rate for the household population under age 65
- AF<65 = net overseas Armed Forces movement under age 65

Net International Migration: The net international migration component for the estimates of the under age 65 population combines four parts: (a) net international migration of the foreign born, (b) net migration between the United States and Puerto Rico, (c) emigration of natives from the United States, and (d) net movement of the Armed Forces population.

The Vintage 2007 net international migration estimates for the first two parts (net international migration of the foreign born and net migration between the United States and Puerto Rico) are created using a combination of the Vintage 2006 estimate and a new method, which we anticipate using for Vintage 2008 and later years. The estimate of emigration of natives from the United States remains unchanged from Vintage 2006.

The Vintage 2007 net international migration estimate for the foreign-born population is created by averaging the Vintage 2006 estimate and the estimate generated using a new method for calculating foreign-born migration to and from the United States (50 states and District of Columbia). The Vintage 2006 estimate uses the change in the number of foreign born in two consecutive years of American Community Survey (ACS) data, with an adjustment for deaths to the foreign-born population. The new method utilizes information from the ACS on the reported residence of the foreign-born population in the prior year. Those who reported being abroad in the year prior to the survey are considered immigrants. We estimate the number of foreign-born emigrants separately using a residual method utilizing Census 2000 and ACS data. Subtracting the emigrants from the immigrants results in the new method's net international migration estimate for the foreign-born population. This estimate is then averaged with the Vintage 2006 estimate of the same population group to create the Vintage 2007 estimate. To distribute the national-level estimate to lower levels of geography and characteristics groups (including the under age 65 population), we apply the county-age-sex-race-Hispanic origin distribution of the noncitizen foreign-born population from Census 2000 who entered in 1995 or later to the national-level estimate of net migration of the foreign born.

The Vintage 2007 estimate of net migration between the United States and Puerto Rico is created by averaging the Vintage 2006 estimates and new estimates generated using American Community Survey (ACS) and Puerto Rico Community Survey (PRCS) data. For the 2000 to 2004 time periods, we estimate the net migration using levels observed during the 1990s.¹ In Vintage 2006, this estimate was held constant and carried forward to the end of the estimate period. In Vintage 2007, we average these constant estimates with new estimates for the 2004 through 2006 time periods. The new estimates utilize ACS and PRCS data on residence one year ago, subtracting the estimate of emigration from the United States to Puerto Rico from the estimate of immigration from Puerto Rico to the United States. For the net movement of the under age 65 population between Puerto Rico and the United States, we base the distribution on the characteristics (age, sex, race, Hispanic origin) and geographic location (county) of the Census 2000 population born in Puerto Rico and who entered the United States in 1995 or later.

For Vintage 2007, we estimate native emigration using levels observed during the 1990s.² We assume these emigrants are likely to have the same geographic and characteristics distributions as natives who currently reside in the United States. Therefore, we apply the Census 2000 age, sex, race, Hispanic origin, and county distribution of natives residing in the 50 states and the District of Columbia to the native emigrant population.

We derive county-level data on net overseas movement of the Armed Forces population under age 65 for the current estimate period using a three-stage process. First, we distribute the national-level overseas Armed Forces movement total to states using Armed Forces data originally supplied by the Defense Manpower Data Center (DMDC). Then, we distribute these state-level data to counties using the geographic distribution of the Armed Forces data from Census 2000. Finally, we control the county-level data to the original national-level data to make sure the component data sum as required.

Net Change in the Group Quarters Population: We use data on the change in the group quarters population to measure the domestic migration of the group quarters population under age 65. We use group quarters population data from two sources to estimate county populations: (1) Census 2000 group quarters population by single year of age and facility type (i.e., correctional institutions, juvenile facilities, nursing homes, other institutional facilities, university dormitories, military barracks, other noninstitutional facilities) for each subcounty area (e.g., cities, towns, etc.) and (2) a time series of individual group quarters records from the Group Quarters Report (GQR) prepared by the FSCPE members.

We use these group quarters population data to derive a time series of group quarters population. First, we sum the group quarters populations from Census 2000 and the GQR to the subcounty level by facility type for each estimate date in the time series.

Then, we calculate the time series of subcounty group quarters population by GQ type from July 1, 2000 to July 1, 2007 by adding the year-to-year change given by the GQR data. We use the following formula:

$$GQTOT_{x,t} = GQTOT_{x-1,t} + (GQRTOT_{x,t} - GQRTOT_{x-1,t})$$

Where:

- x = current estimate year
- t = facility type
- GQTOT = subcounty group quarters population of all ages
- GQRTOT = subcounty GQR population of all ages

We sum the subcounty population to the county level by type and derive the total group quarters population under age 65 by GQ type from the total GQ population by type using age distribution data from Census 2000. We use the following formula:

$$GQ<65_{x,t} = (GQ<65_{C2000,t} / GQ_{C2000,t}) * GQTOT_{x,t}$$

Where:

- C2000 = Census 2000 reference date
- x = current estimate year
- t = facility type
- GQ<65 = county group quarters population under age 65
- GQ = county group quarters population of all ages
- GQTOT = county group quarters population of all ages

Finally, we sum the county group quarters population under age 65 by type to calculate the county under age 65 group quarters population.

Calculating the Population Under Age 65

The formula for estimating the county-level population under age 65 from the base populations and components of population change described above is as follows:

$$U65_x = U65HP_{x-1} + PB_x - PD<65_x + MIG<65_x + GQ<65_x + FBINAT<65_x - EMIG<65_x + NMPR<65_x + AF<65_x$$

Where:

x	= current estimate year
U65	= total population under age 65
U65HP	= base household population under age 65
PB	= period births to the household population
PD<65	= period deaths to the household population under age 65
MIG<65	= net domestic migration of the household population under age 65
GQ<65	= group quarters population under age 65
FBINAT<65	= net foreign-born international migration of the population under age 65
EMIG<65	= native emigration of the population under age 65
NMPR<65	= net movement to or from Puerto Rico under age 65
AF<65	= net overseas Armed Forces movement

Estimating the Population Aged 65 and Older

Base Populations

We begin the process of producing estimates of the aged 65 and older population by preparing the required base populations for each county: the base resident population aged 65 and older, the base group quarters population aged 65 and older, the base household population aged 65 and older, and the population base of potential domestic migrants aged 65 and older.

For the first three base populations, the process is identical to the process described above for the base population under age 65. The base resident population aged 65 and older is either the revised county estimate of the resident population aged 65 and older or the Census 2000 base population aged 65 and older, depending on the estimate date. The base group quarters population aged 65 and older is the total group quarters population for the estimate date excluding the under age 65 group quarters population. We calculate the household population base by a residual method, as described below:

$$O65HP_{x-1} = EPO65_{x-1} + EX64_{x-1} - GQ65+_{x-1}$$

Where:

x	= current estimate year
O65HP	= base household population aged 65 and older
EPO65	= population aged 65 and older
EX64	= population age 64 in the previous estimate year (who will turn age 65 in the current estimate year).
GQ65+	= group quarters population aged 65 and older

The process we use to derive the population base of potential domestic migrants aged 65 and older is similar to that used for the under age 65 population, with the following modifications.

First, we use Medicare enrollment data to calculate the migration rate. We exclude the current year's net migration of the foreign-born population from the migration base because we assume they are not eligible for Medicare. The basic formula is as follows:

$$OBASE65_{+x} = O65HP_{x-1} + (.5 * (- PD65_{+x} - EMIG65_{+x} + NMPR65_{+x}))$$

Where:

- x = current estimate year
- OBASE65+ = population base of potential domestic migrants aged 65 and older
- O65HP = base household population aged 65 and older
- PD65+ = period deaths to the household population aged 65 and older
- EMIG65+ = native emigration of the population aged 65 and older
- NMPR65+ = net movement to or from Puerto Rico aged 65 and older

Components of Population Change

To produce county-level estimates of the resident population aged 65 and older, we use the same administrative records data sources described in the under age 65 section above for resident deaths, net international migration, and net change in the group quarters population, each tabulated now for the aged 65 and older population.

Instead of using IRS tax return data to calculate the net domestic migration rate of the household population, we use modified tabulations of Medicare enrollees aged 65 and older in each county obtained from the Centers for Medicare and Medicaid Service (CMS).³ We derive the net domestic migration rate for each county from the difference between the in-migration and out-migration of Medicare enrollees using the following formula:

$$NiMR65_{+} = ((MED_x * MEDCOV) - ((MED_{x-1} * MEDCOV) + EX64_x + NMPR65_{+x} - EMIG65_{+x} - PD65_{+x})) / MED_{x-1} * MEDCOV$$

Where:

- x = current estimate year
- NiMR65+ = net domestic migration rate for the household population aged 65 and older
- MED = number of Medicare enrollees
- EX64 = population age 64 in the estimate year (who will turn age 65 in the current estimate year)
- NMPR65+ = net movement to or from Puerto Rico aged 65 and older
- EMIG65+ = native emigration of the population aged 65 and older
- PD65+ = deaths to the population aged 65 and older
- MEDCOV = Medicare coverage rate, which is calculated using the following formula:

$$MEDCOV = MED_{2000} / POP65_{+C2000} * COVUPDATE$$

Where:

- C2000 = Census 2000 reference date

MED = county number of Medicare enrollees
 POP65+ = county population aged 65 and older
 COVUPDATE = national level ratio of Medicare coverage in the estimate year to Medicare coverage in the last census year

Once we have calculated the net migration rate, we apply that rate to the domestic migration population base aged 65 and older. From that, we subtract the net movement from Puerto Rico and the native emigration.

$$MIG65_{+x} = (OBASE65_{+x} * NiMR65_{+x}) - (NMPR65_{+x} - EMIG65_{+x})$$

Where:

x = current estimate year
 MIG65+ = domestic migration of the household population aged 65 and older
 OBASE65+ = population base of potential domestic migrants aged 65 and older
 NiMR65+ = net domestic migration rate for the household population aged 65 and older
 NMPR65+ = net movement to or from Puerto Rico aged 65 and older
 EMIG65+ = native emigration of the population aged 65 and older

Calculating the Population Aged 65 and Older

The formula to estimate the county population aged 65 and older using the base population and the components of population change is as follows:

$$O65_x = O65HP_{x-1} - PD65_{+x} + MIG65_{+x} + GQ65_{+x} + FBINAT65_{+x} - EMIG65_{+x} + NMPR65_{+x}$$

Where:

x = current estimate year
 O65 = total population aged 65 and older
 O65HP = base household population aged 65 and older
 PD65+ = period deaths for the household population aged 65 and older
 MIG65+ = domestic migration of the household population aged 65 and older
 GQ65+ = group quarters population aged 65 and older
 FBINAT65+ = net foreign-born international migration of the population aged 65 and older
 EMIG65+ = native emigration of the population aged 65 and older
 NMPR65+ = net movement to or from Puerto Rico aged 65 and older

Calculating the Total Resident Population

Controlling the Population Estimates

We control the county estimates to the national estimates using rake factors to ensure consistency between the county-level total resident population estimates and the independently produced national resident population estimates. The rake factor for the population under age 65 is a ratio

of the national estimate under age 65 to the sum of the estimated resident population under age 65 for all counties in the nation. We apply this rake factor to each county population under age 65 to adjust all county populations proportionally so the sum of the county estimates equals the national estimate under age 65. We use the same process to control the estimated county resident population aged 65 and older to the national estimate aged 65 and older.

Administrative Components of Population Change

We incorporate data from other administrative sources into the estimates as necessary. These other sources include revisions from the population review and update program (challenges) to the population estimates and the results of whole-entity special censuses, test censuses, and dress rehearsal censuses.^{4,5}

Calculating the Total Population

Finally, we sum the raked population under age 65 and the raked population aged 65 and older to produce the total population for each county and sum the county populations in each state to produce the total population for each state.

Special Section: Estimating the Three-Month Period from April 1 to July 1, 2000

We produce the estimated change in population for the three-month period between April 1 and July 1 of the decennial census year using the same method as above, but we incorporate three-months of data instead of a full year of data. We derive the three months of data by taking one-quarter of the data for the period from July 1, 1999 to June 30, 2000. The only exceptions to this approach are Armed Forces movement to/from overseas data, vital statistics data, and group quarters data. For these components, we use actual administrative records for April 1, 2000 to July 1, 2000.

¹ For more information on the estimate of net movement from Puerto Rico see Christenson, M., 2002, "Evaluating Components of International Migration: Migration Between Puerto Rico and the United States," Population Division Technical Working Paper No. 64.

² For information on estimates of native emigration, see Gibbs, J., G. Harper, M. Rubin, and H. Shin, 2003, "Evaluating Components of International Migration: Native-Born Emigrants," Population Division Technical Working Paper No. 63.

³ For more information on modifications made to the Medicare data as of July 1, 2006 and July 1, 2007 to incorporate the impact of Hurricanes Katrina and Rita, see <http://www.census.gov/popest/topics/methodology/2007-hurr-spcl-meth.html>

⁴ For more information on this program, see <http://www.census.gov/popest/archives/challenges.html>

⁵ For more information on the special census program, see http://www.census.gov/field/www/specialcensus/files/program_overview.htm