

State and County Total Resident Population Estimates Method: July 1, 2006

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

Background

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 and then summing all county populations within each state to produce the state population estimates. The following documentation describes the work that was carried out to produce the July 1, 2006 total resident population estimates at the county level.

Overview

The Census Bureau develops county population estimates with an administrative records component of population change method in which the household and group quarters population are estimated independently. State population estimates are simply the sum of all county population estimates within each state. For the household population, the components of population change are births, deaths, net domestic migration, net international migration, and net

military movement to and from overseas. Change in the non-household, or group quarters, population is measured by the net change in the population living in group quarters facilities. A major assumption underlying this approach is that the components of population change are closely approximated by measuring change in selected administrative or survey data sources. Therefore, Census Bureau demographers estimate each component of population change separately from administrative records including registered births and deaths, federal income tax returns, Medicare enrollees, and military movement. Data from the American Community Survey are also incorporated into the estimates.

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

Method

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

Summary

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 for all years after 2000). We then add or subtract the demographic components of population change calculated for the time period. Basically, we add the estimated number of births and subtract the estimated number of deaths for the time period. Next, we add the estimates of net domestic migration, net foreign-born

international migration, net movement to/from Puerto Rico, net Armed Forces movement to/from overseas, net native emigration from the United States, and the change in group quarters population.

We produce separate population estimates for the populations under age 65 and age 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 data from individual federal tax returns to estimate net domestic migration. We use Medicare enrollment to calculate measures of migration for the population age 65 and older because this population is not always well represented on tax returns.

The following text describes, in more detail, the production of population estimates for these two populations.

Step 1: Estimating the Population Under Age 65

Base Populations

To begin the process of producing population estimates under age 65 with a component of change method, 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 updates.

The group quarters population component is primarily a combination of military personnel living in barracks, college students living in dormitories, persons residing in institutions, inmates of correctional facilities, and persons in health care facilities. To produce the base group quarters population under age 65, we exclude persons age 65 and older residing in nursing homes and other facilities.

After we subtract both the base group quarters population under age 65 and the resident population, who will turn 65 during the estimate interval, from the base resident population under age 65, we produce a residual population defined as 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 age 65 and older

GQ<65 = group quarters population under age 65

As the name suggests, the population base of potential domestic migrants under age 65 should include all people who have the potential to move domestically throughout 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, the best 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, persons experiencing these events have the potential for domestic migration, 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: estimated resident births minus estimated resident deaths, plus estimated 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 movement of the Armed Forces population to/from overseas, 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 exemptions that are under age 65. We derive net domestic migration rates using these data and then apply these rates to the household population 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 associated exemptions:

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

Where:

x = current estimate year

NiMR<65 = net domestic migration rate for the household population under age 65

INST = in-migrants from another state
INCTY = in-migrants from another county within the same state
OUTST = out-migrants to another state
OUTCTY = out-migrants to another county within the same state
NON = nonmigrants

Once we have calculated the net migration rate, we apply that rate to the domestic migration population base under age 65 and subtract the county net Armed Forces movement of the population under age 65, as their movement is accounted for by the data we receive from each branch of the Armed Services, 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 Armed Forces movement to/from overseas under age 65

Net International Migration: We estimate the net international migration for population under age 65 to/from the United States from several sources. Our estimate of the net international migration component for the under age 65 population includes 3 separate pieces: net foreign-born international migration, net movement to/from Puerto Rico, and net native emigration. We produce each of these three pieces of international migration at the national level and then distribute them to counties based on the Census 2000 geographic distributions that are most similar to each piece.

To produce the net foreign-born international migration of the population under age 65 for the current estimate period, we start with the national-level under 65 net foreign-born international migration component derived from 2000-2005 American Community Survey data. We distribute this national data to counties based on the Census 2000 county distribution of the non-citizen foreign-born population who entered the U.S. during the 5 years prior to April 1, 2000. We use the following formula:

$$FBINAT<65_{NAT,x} = NFBINAT<65_{NAT,x} * (FB<65_{NAT,C2000} / NFB<65_{NAT,C2000})$$

Where:

x = current estimate year

FBINAT<65 = county net foreign-born international migration under age 65

NFBINAT<65 = national net foreign-born international migration under age 65

FB<65 = county noncitizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000

NFB<65 = national noncitizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000

For the net movement to/from Puerto Rico under age 65, we start with national-level under age 65 net movement to/from Puerto Rico data. In this case, we distribute the national net movement of the population under age 65 to or from Puerto Rico to counties based on the Census 2000 county distribution of the Puerto Rican population who entered the U.S. during the five years prior to April 1, 2000. We use the following formula:

$$NMPR<65_x = NATNMPR<65_x * (PR<65_{C2000} / NATPR<65_{C2000})$$

Where:

x = current estimate year

NMPR<65 = county net movement to/from Puerto Rico under age 65

NATNMPR<65 = national net movement to/from Puerto Rico under age 65
 PR<65 = county population under age 65 born in Puerto Rico who entered the U.S. during the five years prior to April 1, 2000
 NATPR<65 = national population under age 65 born in Puerto Rico who entered the U.S. during the five years prior to April 1, 2000

Finally for the net emigration of the native population under age 65, we distribute the national-level data on the total number of net native emigrants from the United States under age 65 for the current estimate period to counties based on the Census 2000 county distribution of the native-born population. We use the following formula:

$$EMIG<65_x = NATEMIG<65_x * (NATIVE<65_{C2000} / NATNATIVE<65_{C2000})$$

Where:

C2000 = Census 2000 reference date
 x = current estimate year
 EMIG<65 = county native emigration of the population under age 65
 NATEMIG<65 = national native emigration of the population under age 65
 NATIVE<65 = county native population under age 65
 NATNATIVE<65 = national native population under age 65

Net Movement of the Armed Forces Population: We derive county-level data on net overseas movement of Armed Forces under age 65 for the current estimate period using a three-stage process. First, we distribute the national-level total Armed Forces movement data to states using Armed Forces data originally supplied by each branch of the service. Then, we distribute these state-level data to counties using the geographic distribution of the military employment data from Census 2000. Finally, we control the county-level data to original national-level data to make sure the component data sums 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 non-institutional 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.

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, 2006 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:

C2000 = Census 2000 reference date

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 the county level under age 65 group quarters population to calculate county-level population estimates.

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
PD<65	= period deaths to the 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/from Puerto Rico under age 65
AF<65	= net Armed Forces movement to/from overseas under age 65

Step 2: Estimating The Population Age 65 And Older

Base Populations

We start the process of producing population estimates age 65 and older with the required base populations: the base resident population age 65 and older, the base group quarters population age 65 and older, the base household population age 65 and older, and the population base of potential domestic migrants age 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 age 65 and older is either the revised county estimate of the resident population age 65 and older or the Census 2000 base population age 65 and older, depending on the estimate date. The base group quarters population age 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 shown next.

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

Where:

x = current estimate year

O65HP = base household population age 65 and older

EPO65 = population age 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 age 65 and older

The process we use to derive the population base of potential domestic migrants age 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:

$$OBASE65+_x = O65HP_{x-1} + (.5 * (AF65+_x - PD65+_x - EMIG65+_x + NMPR65+_x))$$

Where:

x = current estimate year

OBASE65+ = population base of potential domestic migrants age 65 and older

O65HP = base household population age 65 and older

AF65+ = net Armed Forces movement to/from overseas age 65 and older

PD65+ = period deaths to the population age 65 and older

EMIG65+ = native emigration of the population age 65 and older

NMPR65+ = net movement to/from Puerto Rico age 65 and older

Components of population change

To produce county-level estimates of the resident population age 65 and older, we use the same components of change described in the under age 65 section

above, resident deaths, net domestic migration, net international migration, net movement of the Armed Forces population to/from overseas, and net change in the group quarters population, tabulated for the age 65 and older population, with the following exceptions.

We use tabulations of Medicare enrollees in each county obtained from the Centers for Medicare and Medicaid Service (CMS) to calculate the net domestic migration rate of the household population age 65 and older. We derive a net domestic migration rate (NiMR65+) for each county, from the difference between the in-migration and out-migration of Medicare enrollees using the following formula:

$$\text{NiMR65+} = ((\text{MED}_x * \text{MEDCOV}) - ((\text{MED}_{x-1} * \text{MEDCOV}) + \text{EX64}_x + \text{AF65+}_x + \text{NMPR65+}_x - \text{EMIG65+}_x - \text{PD65+}_x)) / \text{MED}_{x-1} * \text{MEDCOV}$$

Where:

x = current estimate year

NiMR65+ = net domestic migration rate for the household population age 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)

AF65+ = net Armed Forces movement to/from overseas age 65 and older

NMPR65+ = net movement to/from Puerto Rico age 65 and older

EMIG65+ = native emigration of the population age 65 and older

PD65+ = deaths to the population age 65 and older

MEDCOV = Medicare coverage rate, which is calculated using the following formula:

$$\text{MEDCOV} = \text{MED}_{2000} / \text{POP65+}_{\text{C2000}} * \text{COVUPDATE}$$

Where:

C2000 = Census 2000 reference date

MED = county number of Medicare enrollees
 POP65+ = county population age 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 age 65 and older (OBASE65+). From that, we subtract the Armed Forces movement to/from overseas (AF65+), the net movement from Puerto Rico (NMPR65+) and the native emigration (EMIG65+) to prevent double counting.

$$MIG65+_x = (OBASE65+_x * NiMR65+_x) - (AF65+_x + NMPR65+_x - EMIG65+_x)$$

Where:

x = current estimate year
 MIG65+ = domestic migration of the household population age 65 and older
 OBASE65+ = population base of potential domestic migrants age 65 and older
 NiMR65+ = net domestic migration rate for the household population age 65 and older
 AF65+ = net Armed Forces movement to/from overseas age 65 and older
 NMPR65+ = net movement to/from Puerto Rico age 65 and older
 EMIG65+ = native emigration of the population age 65 and older

If the net migration (MIG65+) is preceded by a minus sign (-), then the figure indicates net out-migration; otherwise, the figure represents net in-migration.

Calculating the Population Age 65 and Older

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

$$O65_x = O65HP_{x-1} - PD65+_x + MIG65+_x + GQ65+_x + FBINAT65+_x - EMIG65+_x + NMPR65+_x + AF65+_x$$

Where:

- x = current estimate year
- O65 = total population age 65 and older
- O65HP = base household population age 65 and older
- PD65+ = period deaths for the population age 65 and older
- MIG65+ = domestic migration of the household population age 65 and older
- GQ65+ = group quarters population age 65 and older
- FBINAT65+ = net foreign-born international migration of the population age 65 and older
- EMIG65+ = native emigration of the population age 65 and older
- NMPR65+ = net movement to/from Puerto Rico age 65 and older
- AF65+ = net Armed Forces movement to/from overseas age 65 and older

Step 3: Calculating The Total Population

Controlling the Population Estimates

To ensure consistency between the county-level total resident population estimates and the independently produced national resident population estimates, we control the county estimates to the national estimates using rake factors. 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 equals the national estimate under age 65. We use the same process to control the estimated county resident population age 65 and older to the national estimate age 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 local update and review program to the population estimates and the results of whole-entity special censuses, test censuses, and dress rehearsal censuses. [\[1\]](#), [\[2\]](#)

Calculating the Total Population

To produce the total population for each county, we sum the raked population under age 65 and the raked population age 65 and older. The total population for each state is the sum of the county populations in that state.

Special Section: Estimating The Three-Month Period

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 data for April 1, 2000 to July 1, 2000.

[\[1\]](#) For more information on this program, see <http://www.census.gov/popest/archives/challenges.html>.

[2] For more information on the special census program, see http://www.census.gov/field/www/specialcensus/files/program_overview.htm.
[PDF Version of this methodology](#) [22k]