# ESTIMATES AND PROJECTIONS AREA DOCUMENTATION
# STATE AND COUNTY TOTAL POPULATION ESTIMATES

## BACKGROUND

The U.S. Census Bureau annually produces estimates of total resident population for each state and county. County population estimates are produced with a component of population change method, while the state population estimates are the sum of all county populations within the state. The following documentation describes the work that was carried out to produce the July 1, 2005 total resident population estimates at the county level.

## OVERVIEW

The Census Bureau develops county population estimates with a demographic procedure called an "administrative records component of population change" method. 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 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. In order to apply the model, Census Bureau demographers estimate each component of population change separately.

Administrative records include 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 becomes available, the past year's estimates are continuously revised so that the current year is always based on the most recent data available.

## METHOD

We produce the estimates of the county populations, starting with the base populations from either Census 2000 or the revised population estimate for the most recent year and 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. We then add net domestic migration, net foreign-born international migration, net movement to/from Puerto Rico, net Armed Forces movement to/from overseas, 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 internal 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 describes how we produce population estimates for these two populations.

## STEP 1: ESTIMATING THE POPULATION UNDER AGE 65

### 1A. Base Populations

**1A-1. Total base population under age 65 -** The base population for the estimate of the population under age 65 is the revised county population estimate for the prior estimate year. 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, corrections from Notes and Errata, and geographic updates.

**1A-2. Base group quarters population under age 65 -** The group quarters population component is primarily a combination of military personnel living in barracks, college students living in dormitories and persons residing in institutions. Inmates of correctional facilities, persons in health care facilities and persons in Job Corps Centers are also included in this category. We have excluded persons age 65 and older residing in nursing homes and other facilities from this category since they are included in the estimate of the population age 65 and older.

**1A-3. Base household population under age 65 -** After we subtract the base group quarters population under age 65 from the base total population under age 65 we have a residual that we call 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:

U65HP is the county base household population under age 65

AREST is the total county population for all ages

EPO65 is the county population age 65 and older

GQ<65 is the county group quarters population under age 65

EX64 is the county population age 64 in the previous estimate year (who will turn age 65 in the current estimate year).

Note: In the above formulas -

x-1 denotes the previous estimate year

**1A-4. Population base of potential internal migrants under age 65 -** The population base of potential internal migrants is defined as the midpoint population of the period since the population at the beginning of the estimate period has not yet experienced the births and deaths that are reflected in the population at the end of the period. Also, the population at the end of the estimate period includes in-migrants and excludes out-migrants. The best compromise is to take the population at the midpoint of the period.

We assume that the occurrence of estimated resident births, estimated deaths to people under age 65, and net international migration are evenly distributed throughout the estimate interval. Therefore, they have the potential for migration, on average, for one-half of the period. We develop the internal migration 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 under 65 years, plus estimated net international migration. The base internal migration population under age 65 is calculated 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:

| | |
|---|---|
| MBASE<65 | is the county population base of potential internal migrants under age 65 |
| U65HP | is the county base household population under age 65 |
| PB | is the county-level period births |
| PD<65 | is the county-level period deaths to the population under age 65 |
| FBINAT<65 | is the county net foreign-born international migration of the population under age 65 |
| EMIG<65 | is the county native emigration of the population under age 65 |
| NMPR<65 | is the county net movement to/from Puerto Rico under age 65 |

Note: In the above formula -

| | |
|---|---|
| x | denotes the current estimate year |
| x-1 | denotes the previous estimate year |

**1B. Components of population change**

**1B-1. Resident births -** Resident births are recorded by residence of mother, regardless of where the birth occurred; hence, a county need not have a hospital in order to have resident births.

**1B-2. Resident deaths to population under age 65 -** We use death data tabulated by the most recent residence of the decedent, not by the place where the death occurred.

**1B-3. Net internal migration for population under age 65 -** We estimate the net internal migration within the United States during the estimate interval. Our estimate includes household migration derived from Federal income tax returns and the change in the group quarters population.

> **1B-3a. Migration from Federal Income Tax Returns -** We use data from Federal income tax returns supplied by the Internal Revenue Service (IRS) to measure part of the internal migration of the population under age 65. These data are limited to filers and their exemptions who are under age 65. We derive net internal migration rates using these data and then apply these rates to the household population under age 65.
>
> **Part 1. Internal Migration Rate -** The net internal migration rate for the household population under age 65 for each county is calculated using the following formula, which is based on the difference between the in-migration and out-migration of tax filers and their dependents:
>
> $NiMR{<}65_x = [(INST_x + INCTY_x) - (OUTST_x + OUTCTY_x)] / (NON_x + OUTST_x + OUTCTY_x)$

Where:

| | |
|---|---|
| NiMR<65 | is the county net internal migration rate for the household population under age 65 |
| INST | is the county in-migrants from another state |
| INCTY | is the county in-migrants from another county within the same state |
| OUTST | is the county out-migrants to another state |
| OUTCTY | is the county out-migrants to another county within the same state |
| NON | is the county nonmigrants |

**Part 2. Net internal migration -** Net migration for the population under age 65 is the product of the net internal migration rate (NiMR<65) and the base internal migration population under age 65, as calculated using the following formula:

$MIG<65_x = (MBASE<65_x * NiMR<65_x) - AF<65_x$

Where:

| | |
|---|---|
| MIG<65 | is the county net internal migration of the household population under age 65 |
| MBASE<65 | is the county population base of potential internal migrants under age 65 |
| NiMR<65 | is the county net internal migration rate for the household population under age 65 |
| $AF<65_x$ | is the county net Armed Forces movement to/from overseas under age 65 |

**1B-3b. Migration from Change in Group quarters Population -** We use data on the change in the group quarters population to measure part of the internal migration of the population under age 65. We use group quarters population data from two sources to estimate county populations: (1) Census 2000 counts of group quarters population by single year of age and facility type for each subcounty area, and (2) a time series of individual group quarters records from the Group Quarters Report (GQR). Subcounty areas are commonly referred to as places, cities, towns, etc. These areas represent functioning governmental units and residual pieces thereof.

These two sets of group quarters population data are used to derive a time series of group quarters population through the following process:

**Part 1.** We sum the group quarters populations from Census 2000 and the GQR to the subcounty level by the seven facility types for each estimate date in the time series.

**Part 2.** We assume no change in the group quarters population between April 1, 2000 and July 1, 2000. The time series of subcounty group quarters population by GQ type from July 1, 2000 to July 1, 2005 is then calculated by adding the year to year change given by the GQR data, using the following formula:

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

Where:

GQTOT is the subcounty group quarters population of all ages

GQRTOT is the subcounty GQR population of all ages

**Part 3.** The subcounty numbers are summed to the county level by type for the calculation of county population estimates.

**Part 4.** We 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 in the following formula:

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

Where:

GQ<65 is the county group quarters population under age 65

GQ<65 is the county group quarters population under age 65

GQ is the county group quarters population of all ages

GQTOT is the county group quarters population of all ages

**Part 5.** The county group quarters population under age 65 by type is summed to the total county level under age 65 group quarters population for the calculation of county population estimates.

Note: In the above formulas-

C2000 denotes a Census 2000 reference date

x denotes the current estimate year

x-1 denotes the previous estimate year

t denotes the facility type (correctional institutions, juvenile facilities, nursing homes, other institutional facilities, university dormitories, military barracks, other noninstitutional facilities)

**1B-4. Net international migration for population under age 65 -** We estimate the net international migration to/from the United States from several sources. Our estimate includes the net foreign-born international migration, net movement to/from Puerto Rico, native emigration, and net Armed Forces movement to/from overseas.

**1B-4a. Net foreign-born international migration -** National-level data on the net foreign-born international migration of the population under age 65 for the current estimate period are distributed to counties based on the county distribution of the non-citizen foreign-born population who entered the U.S. during the 5 years prior to April 1, 2000 from Census 2000 using the following formula:

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

Where:

| | |
|---|---|
| FBINAT<65 | is the county net foreign-born international migration under age 65 |
| NFBINAT<65 | is the national net foreign-born international migration under age 65 |
| FB<65 | is the county non-citizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000 |
| NFB<65 | is the national non-citizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000 |

**1B-4b. Net movement from Puerto Rico -** National-level data on the total net movement of the population under age 65 to or from Puerto Rico for the current estimate period are distributed to counties based on the county distribution of the Puerto Rican population who entered the U.S. during the five years prior to April 1, 2000 from Census 2000 using the following formula:

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

Where:

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

**1B-4c. Native emigration from the United States -** National-level data on the total number of emigrants from the United States under age 65 for the current estimate period are distributed to counties based on the county distribution of the native-born population from Census 2000 using the following formula:

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

Where:

| | |
|---|---|
| EMIG<65 | is the county native emigration of the population under age 65 |
| NATEMIG<65 | is the national native emigration of the population under age 65 |
| NATIVE<65 | is the county native-born population under age 65 |
| NATNATIVE<65 | is the national native-born population under age 65 |

Note: In the above formulas -

| | |
|---|---|
| C2000 | denotes a Census 2000 reference date |
| X | denotes the current estimate year |

**1B-4d. Armed Forces movement to/from overseas -** County-level data on net overseas movement of Armed Forces under age 65 for the current estimate period are derived using a three-stage process. First, the national-level total Armed Forces movement data are distributed to states using Armed Forces data originally supplied by each branch of the service. Second, these state-level data are distributed to counties using the military employment data from Census 2000. Raking occurs at the final step to control county-level data to national-level data.

**1C. Calculating the Population Under Age 65**

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

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

Where:

| | |
|---|---|
| U65 | is the total county population under age 65 |
| U65HP | is the county base household population under age 65 |
| PB | is the county-level period births |
| PD<65 | is the county-level period deaths to the population under age 65 |
| MIG<65 | is the county net internal migration of the household population under age 65 |
| GQ<65 | is the county group quarters population under age 65 |
| FBINAT<65 | is the county net foreign-born international migration of the population under age 65 |
| EMIG<65 | is the county native emigration of the population under age 65 |
| NMPR<65 | is the county net movement to/from Puerto Rico under age 65 |
| AF<65 | is the county net Armed Forces movement to/from overseas under age 65 |

Note: In the above formula -

| | |
|---|---|
| x | denotes the current estimate year |
| x-1 | denotes the previous estimate year |

Note: All components of population change are rounded to the nearest whole number. Where applicable, the differences between the sum of rounded components and the independently produced national components are added to or subtracted from the components for Los Angeles County, California (the county with the greatest population in the United States).

## STEP 2: ESTIMATING THE POPULATION AGE 65 AND OLDER

### 2A. Base Populations

**2A-1. Base total population age 65 and older -** The total base population for the estimate of the population age 65 and older is either the Census 2000 base (for July 1 population estimate in the decennial year) or the revised county population estimate for the prior estimate year. See section 1A-1 for a summary of the changes to the Census 2000 base population.

**2A-2. Base group quarters population age 65 and older -** This component is primarily a combination of persons age 65 and older residing in nursing homes and other facilities and persons residing in institutions. Inmates of correctional facilities, persons in health care facilities, and Armed Forces living in barracks are all included in this category. The base group quarters population for the current estimate year is the revised group quarters population from the prior estimate year. In the first estimate year following the decennial census, the base group quarters population is the group quarters population as enumerated in Census 2000.

**2A-3. Base household population age 65 and older -** After we subtract the base group quarters population age 65 and older from the base total population age 65 and older, we have a residual that we call the base household population age 65 and older. The basic formula is as follows:

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

Where:

O65HP is the county base household population age 65 and older

EPO65 is the county population age 65 and older

EX64 is the county population age 64 in the previous estimate year (who will turn age 65 in the current estimate year).

GQ65+ is the group quarters population age 65 and older

In the above formula -

x-1 denotes the previous estimate year

**2A-4. Population base of potential internal migrants age 65 and older –** The process we use to derive the population base of potential internal migrants age 65 and older is similar to that used for the under 65 population with the following modifications. Net migration of foreign born is excluded from the migration base because we assume they are not eligible for Medicare. See section 1A-4 for a more detailed description. The basic formula is as follows:

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

Where:

OBASE65+ is the county population base of potential internal migrants age 65 and older

O65HP is the county base household population age 65 and older

AF65+ is the county net Armed Forces movement to/from overseas age 65

and older

PD65+ is the county-level period deaths to the population age 65 and older

EMIG65+ is the county native emigration of the population age 65 and older

NMPR65+ is the county net movement to/from Puerto Rico age 65 and older

Note: In the above formula -

x denotes the current estimate year

x-1 denotes the previous estimate year

**2B. Components of population change**

**2B-1. Resident deaths to population age 65 and older -** We use death data tabulated by the most recent residence of the decedent, not by the place where the death occurred.

**2B-2. Net internal migration for population age 65 and older -** We estimate the net internal migration within the United States during the estimate interval. Our estimate includes household migration derived from Medicare enrollment records and the change in the group quarters population.

**2B-2a. Migration from Medicare Enrollment -** We use the tabulations of the number of Medicare enrollees in each county obtained from the Centers for Medicare and Medicaid Service (CMS) to calculate the net internal migration rate. Comparable to IRS data used for the population under age 65, Medicare enrollment data allow us to develop a separate estimate of internal migration for the population age 65 and older.

**Part 1. Internal Migration Rate -** We derive a net internal migration rate (NiMR65+) for the household population age 65 and older for each county, which is based on the difference between the in-migration and out-migration of Medicare enrollees using the following formula:

$$NiMR65+ = (MED_X * MEDCOV) - ((MED_{X-1} * MEDCOV) + EX64_x + AF65+_X + NMPR65+_X - EMIG65+_X - PD65+_X) / MED_{X-1} * MEDCOV$$

Where:

NiMR65+ is the county net internal migration rate for the household population age 65 and older

MED is the county number of Medicare enrollees

EX64 is the county population age 64 in the estimate year (who will turn age 65 in the current estimate year)

AF65+ is the county net Armed Forces movement to/from overseas age 65 and older

NMPR65+ is the county net movement to/from Puerto Rico age 65 and older

EMIG65+ is the county native emigration of the population age 65 and older

PD65+ is the county-level period deaths to the population age 65 and older

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

$$MEDCOV = MED_{2000} / POP65+_{C2000} * COVUPDATE$$

Where:

MED is the county number of Medicare enrollees

POP65+ is the county population age 65 and older

COVUPDATE is a national level ratio of Medicare coverage in the estimate year to Medicare coverage in the last census year

**Part 2. Net internal migration -** Net migration for the population age 65 and older is the product of the sum of the internal migration base population age 65 and older (OBASE65+) and the net internal migration rate (NiMR65+) minus the sum of the Armed Forces movement to/from overseas (AF65+), the net movement from Puerto Rico (NMPR65+) and the native emigration (EMIG65+).

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

Where:

MIG65+ is the county internal migration of the household population age 65 and older

OBASE65+ is the county population base of potential internal migrants age

65 and older

NiMR65+ is the county net internal migration rate for the household population age 65 and older

AF65+ is the county net Armed Forces movement to/from overseas age 65 and older

NMPR65+ is the county net movement to/from Puerto Rico age 65 and older

EMIG65+ is the county native emigration of the population age 65 and older

Note: In the above formulas -

x denotes the current estimate year

x-1 denotes the previous estimate year

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.

**2B-2b. Migration from Change in Group quarters Population -** The process we use to derive the group quarters change for the population age 65 and older is similar to that used for the population under age 65. See section 1B-3 for a more detailed description.

**2B-3. Net international migration for population age 65 and older -** The process we use to derive the international migration for the population age 65 and older is similar to that used for the population under age 65. See section 1B-4 for a more detailed description.

**2C. Calculating the Population Age 65 and Older**

The formula for estimating the county population age 65 and older from 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:

O65 is the total county population age 65 and older

O65HP is the county base household population age 65 and older

| | |
|---|---|
| PD65+ | is the county-level period deaths for the population age 65 and older |
| MIG65+ | is the county internal migration of the household population age 65 and older |
| GQ65+ | is the county group quarters population age 65 and older |
| FBINAT65+ | is the county net foreign-born international migration of the population age 65 and older |
| EMIG65+ | is the county native emigration of the population age 65 and older |
| NMPR65+ | is the county net movement to/from Puerto Rico age 65 and older |
| AF65+ | is the county net Armed Forces movement to/from overseas age 65 and older |

Note: In the above formula -

| | |
|---|---|
| X | denotes the current estimate year |
| x-1 | denotes the previous estimate year |

Note: All components of population change are rounded to the nearest whole number. Where applicable, the differences between the sum of rounded components and the independently produced national components are added to or subtracted from the components for Los Angeles County, California (the county with the greatest population in the U.S.).

## STEP 3: CALCULATING THE TOTAL POPULATION

### 3A. Raking the populations

Raking with a factor is used to ensure consistency between county population estimates and independent estimates of the national population.

**3A-1. Raking the population under age 65 -** The rake factor is the national estimate of the total population under age 65 divided by the sum of the estimated total population under age 65 for all counties in the nation. This factor is multiplied by each county population under age 65.

**3A-2. Raking the population age 65 and older -** The rake factor is the national estimate of the total population aged 65 and older divided by the sum of the estimated total population aged 65 and older for all counties in the nation. This factor is multiplied by each county population age 65 and older.

### 3B. Rounding the populations

After applying the factors to the populations under age 65 and age 65 and older, we may have population estimates with fractional results. To eliminate "fractional people," we round the population estimate to the nearest whole number. Where applicable, the differences between the sum of rounded population estimates and the independently produced national population estimates are added to or subtracted from the population for Los Angeles County, California (the county with the greatest population in the United States).

### 3C. Administrative components of population change (ACOC)

These changes include results of challenges to population estimates, special censuses, test censuses, and dress rehearsal censuses.

### 3D. Calculating the Total Population

The total population for each county is the sum of 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

The estimated change in population for the three-month period between April 1 and July 1 of the decennial census year is produced using the same method as above, but incorporates three-months of data instead of a full year of data. The three months of data are derived 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 (1) the group quarters population - for which we assume no change in the April 1 group quarters population and it is held constant until July 1, (2) Armed Forces movement to/from overseas data, and (3) the vital statistics data - for which we use actual monthly data for April 1, 2000 to July 1, 2000.