

METHODOLOGY FOR THE PUERTO RICO MUNICIPIO POPULATION ESTIMATES BY AGE AND SEX

Overview

The U.S. Census Bureau produces estimates of the resident population for each state and county in the United States, and for the Commonwealth of Puerto Rico and its municipios on an annual basis. In 2006, the U.S. Census Bureau produced municipio estimates of the total population by age and sex using a cohort component method. The following documentation describes the work to produce the July 1, 2006 total resident population estimates by age and sex at the municipio level.

Background

During the 1990s, the Census Bureau produced the Puerto Rico municipio estimates using a ratio-correlation technique. For the post Census 2000 period, the U.S. Census Bureau and the Puerto Rico Planning Board agreed to explore alternative methods for producing the municipio estimates. While research was still ongoing, an interim set of estimates was produced for July 2004 by extrapolating the growth trends of each municipio between 1990 and 2000 and then controlling the results to the independently estimated Commonwealth's resident population.

In 2005, the U.S. Census Bureau needed to develop estimates by age and sex as controls for the Puerto Rico Community Survey. The Census Bureau decided to replace the constant growth rate method, which did not give age-sex estimates, with a cohort component method that uses data on population components to develop estimates of the total population by age and sex.

Cohort Component Method

The cohort-component method follows each birth cohort according to its exposure to fertility, mortality, and migration. The method is based on the traditional demographic accounting system; starting with a base population by age and sex, deaths are subtracted from the population and those surviving become older. Each cohort of children born is also followed through time by exposing it to mortality. Estimates of net migration are added to or subtracted from the population. Mathematically, in a general form it can be expressed as:

$$P_1 = P_0 + B - D + NM$$

Where:

P_1 = population at the end of the period

P_0 = population at the beginning of the period

B = births during the period

D = deaths during the period

NM = net migration during the period

To produce estimates by this method, we used the Rural-Urban Projection (RUP) program developed by the U.S. Census Bureau, which uses a base population and estimates of births, deaths, and migration by age and sex described below.¹

Base Population

The Census Bureau uses unadjusted Census 2000 population by sex and 5-year age groups (under 1, 1-4, 5-9, ...80+) with all corrections and geographic changes as of January 1, 2006 for the estimates base population. The April 1, 2000 base population was moved to July 1, 2000 by applying the average intercensal growth rate between 1990 and 2000 for the municipio as a whole to each 5-year age group.

Births by Sex

Total births of each sex by calendar year 2000 – 2005 for the municipios came from vital registration data provided by the Puerto Rico Planning Board.²

Deaths by Sex

Total deaths of each sex by calendar year 2000 – 2005 for the municipios came from vital registration data provided by the Puerto Rico Planning Board.³ An age pattern of death rates by age and sex from the 1998-2000 Puerto Rico life table was used to distribute total deaths into age groups.

Net Migration

We assumed that the average annualized 1990-2000 net migration rates for each municipio by age and sex apply to the post-2000 period. We estimated net migration rates using the forward survival method, which used municipio data on population from the 1990 census and Census 2000, intercensal births, intercensal deaths, and average intercensal life table survival rates for Puerto Rico. We produced separate net migration estimates for males and females of each municipio. The steps taken to produce these estimates for each municipio are as follows:

1. The 1990-2000 life table 10-year survival rates by age were applied to the 1990 census population⁴ by age to produce estimates of expected survivors in 2000 for the age groups 10-14 and above. These estimates assume no migration. We used intercensal births to produce expected survivors in age groups 0-4 and 5-9 in 2000. In addition, we made an independent estimate of the total expected population in 2000 by adding the intercensal births to the 1990 census population and subtracting from it the intercensal deaths. We used this independent estimate as a control for the age specific survivors.
2. We estimated the number of intercensal net migrants for each age group by taking the difference between Census 2000 population and expected 2000 population.
3. To create an estimate of the annual migration by age and sex, it was important to account for the fact that the total net intercensal migrants associated with a given age cohort actually migrated as members of several different cohort groups, including those to which they belonged at the beginning of the period, and the ones they joined upon turning an age which is a multiple of 5. A rough correction for this was made by shifting the estimate of intercensal migration associated with a given cohort to the

next youngest 5-year cohort, which approximated the average age at migration over the 10-year period. For the 0-4 age group, the 0-4 and 5-9 estimates were added together to give an estimate over the entire 10-year period. These numbers were then divided by the number of years in the intercensal period (10).

4. Finally, to produce an estimated set of annual net migration rates, we divided the estimated annual number of net migrants by the average of the 1990 census and Census 2000 populations.

Resident Population Estimates: Total by Age and Sex

The Census Bureau followed the above steps to produce initial annual estimates of municipio resident population by single year of age and sex for July 1, 2001; July 1, 2002; July 1, 2003; July 1, 2004; July 1, 2005; and July 1, 2006. We derived the final municipio estimates by proportionately adjusting the annual estimates of each age-sex specific category so that the sum over all municipios was equal to the corresponding independently produced age-sex category estimate for Puerto Rico. The total resident population estimate of each municipio was produced as the sum of its final age sex population estimates.

Limitations

The estimates we have prepared have several limitations; the important ones are described below:

The most important limitation of the July 1, 2006 Puerto Rico municipio estimates is the absence of reliable administrative data about migration. First, the assumption that the migration in the post-Census 2000 period follows the 1990s pattern may not be valid. Second, the net migration estimates between 1990 and 2000 calculated with a residual technique include any differential coverage between the 1990 census and Census 2000 at the municipio level. The amount of differential coverage is not known and thus we were not able to adjust migration rates for the coverage differences. Third, in some cases, notably the Florida municipio, changes in legal boundaries between 1990 and 2000 occurred that had an impact on the change in population. We were not able to factor in these boundary changes. Finally, the impact of moderate and large housing construction projects that several municipios started since 2000 to stop losing population was not accounted for in their annual net migration rate. The Census Bureau is currently working with Puerto Rico to obtain tax return data that are expected to improve the migration estimates.

Another potential limitation of the July 1, 2006 estimates relates to the completeness of the birth and death data. We assume the vital statistics data provided by the Department of Health in Puerto Rico and the Puerto Rico Planning Board are complete. However, in the absence of evaluations on completeness, this assumption cannot be validated.

¹ For a more detailed description of the RUP program, see Eduardo E. Arriaga, 1994, Population Analysis with Microcomputers, Volume II: Software and Documentation, Washington, D.C.: U.S. Census Bureau.

² A relatively small number of births, whose municipio of residence was unknown, were distributed over all municipios in proportion to their reported number of births.

³ A relatively small number of deaths, whose municipio of residence was unknown, were distributed over all municipios in proportion to their reported number of deaths.

⁴ The 1990 census population for age 0 was increased by 10 percent to cover a processing error