

ESTIMATES AND PROJECTIONS AREA 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 2005, the U.S. Census Bureau produced municipio estimates of the total population and by age and sex using a cohort component method. The following documentation describes the work to produce the July 1, 2005 total resident population estimates 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 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 and by age and sex.

Cohort Component Method

The cohort-component method follows each cohort of the same age 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 RUP (Rural-Urban Projections) 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 below¹:

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, 2005 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 – 2004 for the municipios came from vital registration data provided by the Puerto Rico Planning Board².

Deaths by Sex

Total deaths of each sex by calendar year 2000 – 2004 for the municipios came from vital registration data provided by the Puerto Rico Planning Board³. An age pattern of death rates by age and sex from the 1998-2000 Puerto Rico life table for Puerto Rico 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 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 occurrence 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 occurrence was unknown, were distributed over all municipios in proportion to their reported number of deaths.

1. We applied the 1990-2000 life table 10-year survival rates by age to the 1990 census population⁴ by age to produce estimates of expected survivals, in the absence of migration, 10 years later in 2000 for age groups 10-14 and above. We used intercensal births to produce expected survivals in age groups 0-4 and 5-9 in 2000. In addition, we made an independent estimate of the total expected population in 2000 from the 1990 census population by adding to it the intercensal births and subtracting from it the intercensal deaths. We used this independent estimate as a control for the age specific survivals.
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. The estimates of net intercensal migrants are the source for the estimates of the annual net migration rates by age. In the computation of rates, we made an age adjustment for the fact that the ages of migrants refer to people who are alive at the end and not at the time of migration. We approximated this adjustment, by shifting the estimate of a given age group to the next youngest 5-year age group. For the age group 0-4, estimated net migrants for 0-4 and 5-9 were added together to give an estimate over entire estimation period.
4. To produce average annual net migration rates, we divided migrants in each age first by 10 and then by the average of the corresponding 1990 and 2000 populations.

Resident Population Estimates: Total and 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, and July 1, 2005. We derived the final municipio estimates by proportionately adjusting the annual estimates of each age sex specific category so that its sum over all municipios was equal to the corresponding independently produced age sex category estimate of Puerto Rico. The total resident population estimate of each municipios 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, 2005 Puerto Rico municipio estimates is the absence of reliable administrative data about migration. First, the assumption that the migration in the post Census period follows the 1990s pattern may not be valid. Second, the net migration estimates between 1990 and 2000 calculated with residual technique also include in them 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, besides migration, in some cases, notably Florida municipio-other factors including change in legal boundaries between 1990 and 2000 occurred that impacted the change in population. We were not able to factor out this boundary changes. Fourth, changes in

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

policies, housing construction since 2000 can alter the migration pattern of an area. In the estimation of migration, these changes are not factored in as well. At this point, however, no additional sources of data have been found that might shed light on the accuracy of our migration estimates.

Another potential limitation of the July 1, 2005 estimates relates to the completeness of the birth and death data. We assume that the data we received from the Department of Health in Puerto Rico and Puerto Rico Planning Board are complete. However, in the absence of direct measures of completeness, this assumption cannot be validated.