

**Certified Estimates of Total Population for Counties in North Carolina
for July 1, 2017
and
Estimates of Total Population for Counties in North Carolina
for July 1, 2010 through July 1, 2017
Technical Documentation**

Demographic & Economic Analysis Section
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Introduction

This document provides an overview of the methods and data used to prepare the certified estimates of the total population of counties in North Carolina that the North Carolina Office of State Budget and Management (OSBM) released in September of 2018. These population estimates replace those produced by this office in September of 2017. OSBM incorporated recent trends in population change and estimated total annual population for the state and each of the 100 counties for July 1, 2010 through July 1, 2017. In addition, OSBM estimated population by sex, single years of age, five categories of race, and separately by Hispanic origin for the state and all 100 counties for the same time period.

Methodology

The population estimates produced by OSBM are the result of an average of two sets of population estimates: (1) a modified version of the U.S. Census Bureau, Vintage 2017 Population Estimates¹ and (2) estimates produced through a composite method estimating different segments of the overall population. This section provides an overview of the methods used to derive these population estimates.

Understanding Population Change: The Demographic Balancing Equation

The demographic balancing equation has two main component processes of population change - natural increase (or decrease) and net migration. Natural increase (or decrease) is the change that occurs as a result of the difference between births and deaths. Natural increase occurs when births to a population exceed deaths within that same population.

Net migration is the difference between the number of in-migrants and out-migrants. A population growing as a result of migration will show positive net migration (more in-migrants than out-migrants). Migrants include both migrants to and from other countries (international migration) and domestic migrants (those moving to and from other states and counties). In context of population estimates, any permanent move from one county to another (or from another country) is considered migration.

The demographic balancing equation is useful in understanding population change and in developing methods for estimating population or any of the components of population change. Demographers use a variety of methods to estimate population, including those described in this document (see Murdock et al. 2006; Murdock and Ellis 1992; Siegel 2002; Swanson and Tayman 2012).

Modified Census Bureau Estimates

In March of 2018, the Population Division of the United States Census Bureau released their Vintage 2017 population estimates for North Carolina counties. The Census Bureau uses administrative records to measure change for each component of the demographic equation.

¹ See <https://www.census.gov/programs-surveys/popest.html>

Using a cohort component technique, the Census Bureau begins with a base population (the previous decennial census or the previous year for a population estimate) and subtracts deaths and adds births and net migration.² The Census Bureau uses vital statistics data (birth and death statistics) to estimate natural increase (or decrease) and several different sources to estimate international and domestic migration.

The base population estimates from the U.S. Census Bureau incorporated corrections to the 2010 Census count as a result of the Count Question Resolution (CQR) program and revisions to data inputs for historical estimates since the decennial census of 2010. The CQR correction included a major change in the group quarters population for Durham and Granville Counties (the population of several prison facilities were incorrectly counted in Granville County rather than Durham County in 2010).

Due to delays in obtaining information on group quarters populations (military bases, nursing homes, children's homes, college and university dormitories, and other facilities), the Census Bureau's Vintage 2017 population estimates assumed that the July 2017 group quarters population for each county would be the same as that present in July 2016. OSBM obtained information on the July 2017 population of military bases and other major facilities by March 2018. In addition, minor changes were made to group quarters populations based upon corrected input for individual group quarters facilities for April 2010 and for yearly estimates through July 2017. Thus, the Office of Management and Budget modified the Census Bureau's 2017 population estimates to include the updated population counts for several group quarters facilities.

Generally, OSBM works closely throughout the year with North Carolina's military bases to obtain current counts of the population living in military quarters and with state and local governments to collect information for a variety of group quarters.³

Alternative Estimates

For the alternative population estimates, OSBM assumed the population age 65 years and older to be the same as that estimated by the U.S. Census Bureau in their Vintage 2017 population estimates, and the population living in group quarters to be the same as the adjusted group quarters population as described above. Then, the Office employed a ratio/correlation technique to estimate the household population younger than age 65 for all 100 counties. The ratio/correlation method is a form of linear regression that incorporates ratios of indicators correlated with population (hence the name: ratio/correlation). OSBM (and its predecessor

²For a detailed description of the methods, see: <https://www.census.gov/programs-surveys/popest/technical-documentation/methodology.html>

³The Office of State Budget and Management works closely with the U.S. Census Bureau through the Federal-State Cooperative for Population Estimates program by collecting and sharing group quarters population and other aggregated data for the U.S. Census Bureau's population estimates program.

organizations) has used some form of the ratio/correlation method to estimate population since it began estimating county populations in the 1960s.

In the regression model for the current population estimates, OSBM expressed the independent variables as the ratio of the percentage share of an indicator variable for a county to the state's value for that indicator for the current year and the corresponding percentage share for 2010. Likewise, the dependent variable is expressed as the ratio of the percentage share of the population for a county to the state's population for the current year and the percentage share of the population for a county to the state's population for 2010 (for further discussion on ratio/correlation models see Siegel 2002:415–16 and Swanson and Tayman 2012:165–85).

After reviewing historical relationships among various symptomatic indicators with decennial census population counts for counties, the OSBM selected three symptomatic indicators to include in its current population estimation model: (x_1) automobile and truck registrations; (x_2) school enrollment in grades 1 through 8⁴; and (x_3) a three-year sum of births⁵.

The current prediction equation is given by:

$$y = 0.06600 + (0.42156 * x_1) + (0.29146 * x_2) + (0.21512 * x_3) + \epsilon,$$

where y , the dependent variable, represents the estimated ratio of the percentage shares of household population under age 65, each of the series indicators (x_1 , x_2 , and x_3) represents the ratio of percentage shares of the indicator variables as described in the paragraph above, and ϵ represents random error.

OSBM then combined the estimated household population age 0 to 64 for counties derived from the ratio/correlation linear regression equation with the independent estimates of the population of military barracks, college dormitories, and other group quarters facilities to yield the estimate of the total population age 0 to 64. The Office added these resulting county population estimates to the estimated population age 65 and older (derived from the U.S. Census Bureau) and controlled to the modified Census Bureau estimates of the state population. Prior to the release of these population estimates, the Demographic and Economic Analysis section of OSBM sent the estimates to local governments for their review and evaluated the county population estimates for consistency and reasonableness.

⁴ School enrollment includes children enrolled in public schools (including charters), private schools and home schools.

⁵ Automobile and truck registrations data were provided by North Carolina Division of Motor Vehicles; school enrollment data was obtained from the North Carolina Department of Public Instruction and the North Carolina Division of Non-Public Education; and vital statistics were obtained from the North Carolina State Center for Health Statistics.

Age, Race, and Sex Detail

This office also produced estimates of the demographic characteristics of the population of the state and each county. These characteristics include sex (male, female); single years of age from birth to age 99 and age 100 and older; five categories of race (American Indian/Alaska Native, Asian, Black, White, and All Others); and Hispanic origin (Hispanic/Non-Hispanic).

In addition to estimating population for counties on a yearly basis, this office produces projections of the total population and the characteristics of the population of the State and all 100 counties in North Carolina. These projections serve as a basis for the characteristics of the population estimated here. These projections use historical trends to project the total population and the total population by race and Hispanic origin from July 1, 2010 through July 1, 2038. Then, OSBM used a cohort component technique to estimate the age characteristics of the population by “aging” the population using the April 1, 2010 Census as a base and adding births and net migration and subtracting deaths based on recent trends in fertility, mortality, and net migration through the projection period. Afterwards, OSBM adjusted the 2010 through 2017 values to account for reported births and deaths. Finally, the Office controlled the demographic characteristics of the population to the total population for each county as estimated in the certified and revised county population estimates for 2010 through 2017.

Comparisons to the U.S. Census Bureau Estimates

These population estimates differ from those released by the U.S. Census Bureau in March and May of 2018 and are not directly comparable to the U.S. Census Bureau estimates. In addition to using different techniques to estimate the population, these population estimates incorporate more recent data regarding vital statistics (births and deaths) and group quarters population.

Limitations

The methods OSBM used to produce the population estimates for North Carolina counties are widely used and accepted methods for estimating population. However, like any estimates, these population estimates have several limitations:

- 1) For the estimates produced from the regression model, it is assumed that the statistical relationships between the indicator variables and population that were present historically are the same for the estimation period (Siegel 2002:416). Any change in that relationship will affect estimated population;
- 2) Several different data sources are used as inputs to the estimation model. Any errors in these data sources may have impacts on the resulting population estimates (Bryan 2004:549).

Every effort has been made to collect current and accurate data for group quarters populations, vital statistics, building permits, school enrollment, and vehicle registrations. This office evaluates the data collected from other sources for consistency. In addition to standard data checks, the use of an averaging of two different population estimates as done by this office has

shown to be a robust method for accounting for estimation error (Bryan 2004; Murdock et al. 2006; Murdock and Ellis 1992; Siegel 2002:428–30).

Citations

- Bryan, Thomas. 2004. "Population Estimates." Pp. 523–60 in *The Methods and Materials of Demography*, edited by J. S. Siegel and D. A. Swanson. Amsterdam: Elsevier.
- Murdock, Steve H. and David R. Ellis. 1992. *Applied Demography: An Introduction to Basic Concepts, Methods, and Data*. Boulder, CO: Westview Press.
- Murdock, Steve H., Chris Kelley, Jeffrey Jordan, Beverly Pecotte, and Alvin Luedke. 2006. *Demographics: A Guide to Methods and Data Sources for Media, Business, and Government*. Boulder, CO: Paradigm Publishers.
- Siegel, Jacob S. 2002. *Applied Demography: Applications to Business, Government, Law, and Public Policy*. San Diego, CA: Academic Press.
- Smith, Stanley K., Jeff Tayman, and David A. Swanson. 2002. *State and Local Population Projections : Methodology and Analysis*. New York: Kluwer Academic/Plenum Publishers.
- Swanson, David A. and Jeff Tayman. 2012. *Subnational Population Estimates*. Springer Science+Business Media.