Certified Estimates of Total Population of Counties in North Carolina as of July 1, 2023

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Revised Estimates of Total Population of Counties in North Carolina for July 1, 2020 through July 1, 2022

Technical Document

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Methods Used to Produce the Estimates of the Total Population of North Carolina Counties for July 1, 2020 and July 1, 2023

Introduction

The State Demographer in the North Carolina Office of State Budget and Management (OSBM) produces population estimates for all North Carolina counties and municipalities annually. The state uses these county population estimates in formulas that distribute state revenues to local communities. These estimates also form the basis of population projections that decisionmakers use to plan for education, transportation, and other services. OSBM estimates the resident population of each county using standard methods and data as this technical document outlines. These population estimates relied on the reported April 1, 2020, population counts for all counties.[1] The office also revised the county population estimates for July 1, 2020 through July 1, 2022 based upon updates to input data. This document presents the procedures OSBM used to produce the population estimates.

Methodology

As in previous years, the OSBM population estimates are the result of an average of two sets of population estimates: (1) a modified version of the U.S. Census Bureau, Vintage 2023 Population Estimates[2] and (2) alternative population estimates that use a composite method estimating different segments of the overall population.

Understanding Population Change: The Demographic Balancing Equation

The population growth (or decline) of a county occurs due to two main components (called components of change): natural increase (or decrease) and net migration. When there are more births than deaths in a county, the county population experiences natural increase. When there are fewer births than deaths, natural decrease occurs. However, the county population may continue to grow even with natural decrease, if the number of people moving into the county exceeds the number leaving as well as the natural decrease. Conversely, a county can grow even with net out-migration if natural increase exceeds the population loss due to out-migration. In the context of population estimates, any permanent move from one county to another (or from another country) is considered migration. Using this understanding 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 2024, the Census Bureau published their Vintage 2023 population estimates for all counties in the United States. The Census Bureau used administrative records to estimate each component of population change. Using a cohort-component technique, the Census Bureau began with a base population for April 1, 2020 (the previous decennial census) and subtracted deaths and added births and

[1] U.S. Census Bureau, 2020 Census, PL94-171.
[2] See https://www.census.gov/programs-surveys/popest.html

net migration.[3] The Census Bureau uses vital statistics data (birth and death statistics) to estimate natural increase (or decrease) and administrative records and survey estimates to model international and domestic migration.

The Census Bureau's production schedule for their population estimates does not always allow for a complete accounting for populations living in major group quarters facilities (such as military bases, nursing homes, children's homes, college and university dormitories, and other facilities).[4] Thus, the Census Bureau's Vintage 2023 population estimates assumed that the July 2023 population for many major group quarters facilities are the same as their 2022 populations. By the time the OSBM produced these population estimates, the July 2023 population for all major facilities were available. In addition, OSBM made minor changes to group quarters populations based upon corrected input for individual group quarters facilities for April 2020 and for yearly estimates through July 2022. Thus, the Office of Management and Budget modified the Census Bureau's 2023 population estimates to include the updated population counts for several group quarters facilities.

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 Census Bureau in their Vintage 2023 population estimates, and the population living in group quarters to be the same as the adjusted group quarters population as described above. Then, OSBM 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 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 2020. 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 2020 (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, OSBM selected four symptomatic indicators to include in its current population estimation model: (x^1) 12-month average automobile and truck registrations for the estimate year; (x^2) total school enrollment in grades 1 through 8[5] for the estimate year; (x^3) a three-year sum of

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

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

[5] School enrollment includes children enrolled in public schools (including charters), private schools, Department of Defense, Cherokee Indian Schools, and home schools.

births (the estimate year plus two previous years), and (x^4) two-year average of voter registrations for ages 18-64 (the estimate year plus the previous year).[6] In addition, any county where 50% or more of the population were living in urban areas in 2020 was designated as urban or 1 and all others were designated as rural or 0 (x^5).

The current prediction equation is given by:

$$y = -0.18150 + (0.29884 * x^1) + (0.19857 * x^2) + (0.22495 * x^3) + (0.41988 * x^4) + (0.04198 * x^5) + \varepsilon,$$

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, x^3, and x^4) represent the ratio of percentage shares of the indicator variables as described in the paragraph above, x^5 indicates whether a county is urban (1) or rural (0) 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. OSBM added the resulting county population estimates to the estimated population age 65 and older (derived from the Census Bureau) and controlled to the modified Census Bureau estimates of the state population. The two population estimates (the US Census Bureau's 2023 population estimates and the OSBM alternative population estimates) were then averaged to produce the final July 1, 2023 population estimates.

Previous years' populations were estimated in a similar way. The revised estimates incorporate updates and corrections to input data. Revisions may include county boundary changes and corrections to 2020 Census base resulting from the US Census Bureau's Boundary and Annexation Survey (BAS) or the Count Question Resolution (CQR) programs.

Comparisons to the U.S. Census Bureau Estimates

The OSBM population estimates differ from those released by the Census Bureau in March 2023 and are not directly comparable to the Census Bureau estimates. In addition to using different techniques to estimate the population, OSBM 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 some limitations:

- For the estimates produced from the regression model, the methods assumed that the statistical relationships between the indicator variables and population that were

[6] OSBM obtained automobile and truck registrations data from the North Carolina Division of Motor Vehicles, school enrollment data from the North Carolina Department of Public Instruction, the North Carolina Division of Non-Public Education, Department of Defense, and US Bureau of Indian Affairs; voter registration data from the North Carolina State Board of Elections; and vital statistics from the North Carolina State Center for Health Statistics. Urban population measures were provided by the United States Census Bureau's 2020 Census.

present historically are the same for the estimation period (Siegel 2002:416). Any change in that relationship will affect the estimated population;

- OSBM uses several different data sources 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.

Das Gupta, Prithwas. 1981. "Inercensal Estimates for the States."

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.

Swanson, David A., and Jeff Tayman. 2012. *Subnational Population Estimates*. Vol. 31. Springer Science+Business Media.