

Projected Population of the State of North Carolina and North Carolina Counties for July 1, 2020 through July 1, 2050

Technical Documentation

Demographic & Economic Analysis Section
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Introduction

Beginning in March 2020, North Carolina’s population experienced extensive social and economic disruptions due to the global COVID-19 pandemic. Like the global pandemic of over 100 years ago, this pandemic has affected population change over the past year and will continue to do so until more of the population is vaccinated and the pandemic is under control.

These projections are prepared using the same methods and assumptions used for our annual projections – mainly that most recent trends in population change and in the components of population change (births, deaths, and net migration) continue into the future. However, in order to account for the impacts of COVID-19, these assumptions were modified for the short term and assume additional deaths, fewer births, and slower net migration due to the pandemic and concomitant economic fallout. As a result, these population projections predict 55,000 fewer people by 2023 than had the pandemic not occurred and 71,000 fewer people by 2050.

This technical document outlines the standard model used to produce the projections of the future population as well as the modifications in the assumptions made for the short term. While these modifications were based upon continual review of current economic and population related trends, and review of the literature on similar historic disruptions, the level of uncertainty has increased beyond what would normally be the case without the challenges of a global pandemic. We will continue to monitor trends to modify our assumptions for the population projections produced later this year.

Overview

This document describes the methods and data used to prepare our annual population projections for the state of North Carolina and its 100 counties. We further outline how these standard projections were modified to account for the impact of the global pandemic. With the exception of the modifications made to the assumptions for the short term, these population projections incorporate pre-pandemic trends in fertility, mortality and net migration.

These Vintage 2020 population projections were released on February 15, 2021 and replace the Vintage 2019 population projections published by this office in December 2019. These population projections were released later than our typical November/December timeframe so we could review more recent vital statistics and other data. Because these would have been normally released at the end of 2020, we have kept the 2020 Vintage description.

To meet the needs of our data users, these population projections have been extended for 30 years through 2050 – beyond the 20-year projection horizon typically provided. Summaries of these projections are available on the [OSBM website](#).

In addition, end users may download three different datafiles. Two of the datafiles include the 2000-2009 intercensal estimates and the 2010-2019 revised and standard estimates produced

by this office in September of 2020, as well as the 2020-2050 population projections. The third file includes only the 2010-2019 population estimates and the 2020-2050 population projections. These datafiles differ in the demographic characteristics presented. The three datafiles include:

- (1) estimates and projections of the population for each year by sex and single years of age;
- (2) estimates and projections of the population for each year and by sex, five categories of race (American Indian/Alaska Native, Asian & Pacific Islander, Black, White and Other) and broad age groups; and
- (3) estimates and projections of the population for each year from 2010 through 2050 by sex, Hispanic origin and race (White and non-White).

2020 Census

The results of the 2020 Census had not been reported when these projections were prepared. These projections continue to use the 2000 and 2010 Census as a basis for the models – along with trends shown in the population estimates and vital statistics through 2019. The state apportionment counts from the 2020 Census (which will include population counts of North Carolinian civilian and military personnel stationed overseas) will be released by April 30, 2021 and county total 2020 Census population counts will be released by September 30, 2021, with more detailed demographic information scheduled for release in 2022.

Methodology

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 change at the county level, any permanent move from one county to another (or from another country) is considered migration.

This demographic equation is useful in understanding population change and in developing methods for estimating or projecting population or for estimating the components of population change. Demographers use a variety of methods to project population, including those described here.¹.

¹ Steve H. Murdock and David R. Ellis, *Applied Demography: An Introduction to Basic Concepts, Methods, and Data* (Boulder, CO: Westview Press, 1992); Steve H. Murdock et al., *Demographics: A Guide to Methods and Data Sources for Media, Business, and Government* (Boulder, CO: Paradigm Publishers, 2006); Jacob S. Siegel, *Applied Demography: Applications to Business, Government, Law, and Public Policy* (United States of America: Academic

Projection Model

The current population projection model includes two main components: a forecast model to project total population and population of each major race and Hispanic origin group and a cohort component method to model the projected change in the age characteristics of the population.

First, the total household population was projected for each of the 100 counties in North Carolina using time-series forecasting models that pattern future population change based upon historical trends in population for each county. For the current set of projections, the office selected a forecast model for each county that most accurately projected the 2010 Census and subsequent (2010-2019) county population estimates. Projections were selected that had low predicted errors [measured in terms of Mean Absolute Percentage Error (MAPE)] for each county using 1990-2019 data. OSBM then added the group quarters population to the projected household population for each county to obtain the projected total population for each county for each year from 2020 through 2050. The summation of these projected total populations for each county yielded the total population by year for the state of North Carolina.

After preparing projections of the total population for all counties and the state, the population of each sex and race group and each sex and Hispanic origin group combination was prepared using time-series forecast models. The resulting projections by sex, race, and Hispanic origin were then controlled to the projections of the total population for each county. The office then summed these sex, race and Hispanic origin population projections for each county and year to obtain the sex, race and Hispanic origin population projections for the state.

Cohort-Component

Race/Sex/Age characteristics

OSBM used a cohort component technique to project the age characteristics of each sex and race combination. This paragraph outlines the general model while subsequent paragraphs detail the modifications made to account for the global pandemic. Estimated survival rates for each age, sex and race combination are based on data from the previous two decennial censuses (2000 and 2010). These survival rates were assumed to remain the same from 2022 through 2050. These survival rates were adjusted based upon actual reported deaths by age, sex, and race between 2010 and 2019 and further adjusted for 2020 and 2021 to account for the impacts of the pandemic. These survival rates were applied to the population for each group at the beginning of each period to project the survived population for the subsequent year (the population assuming no net migration). Estimated net migration was derived by subtracting the survived population for the following year from the population as projected by

Press, 2002); Stanley K. Smith, Jeff Tayman, and David A. Swanson, *State and Local Population Projections : Methodology and Analysis*, The Plenum Series on Demographic Methods and Population Analysis (New York: Kluwer Academic/Plenum Publishers, 2002).

the time-series forecasting models (described above). OSBM adjusted this total net migration for each county for each year for age specific rates of net migration by using net migration trends by age from the previous decade (2000-2010). The resulting net migration by age for each sex and race group added to the survived population by age, sex, and race yielded the final projected population by age; the process was repeated for the next period. An initial model was prepared with the derived measures of total net migration based upon forecasted trends. Net migration was then reduced for 2020 and 2021 in order to account for restrictions on international migration and the impacts of the economic downturn on domestic migration. Beginning in 2022, the model assumes that the level of net migration returns to the previously projected trends.

The final step was to add the population at the youngest age by applying the most recent race specific birth rates by race for the female population age 10 to 49. North Carolina began to experience the impacts of the pandemic in March so that the full impacts on fertility would not begin to show until the end of 2020. Fertility rates were adjusted downward for 2020 and 2021, with a return to pre-pandemic levels of fertility by 2022.

Data

Historic Population

The most fundamental part of any population projection are the historical data from which the projections are derived. The decennial census serves as a basis for the population estimates and projections produced by this office, especially the 2000 and 2010 decennial censuses.

OSBM obtained 2000 and 2010 decennial census population by race, sex, and single years of age from 0-99 and a combined age group for population age 100+ from the Modified Age, Race, and Sex (MARS) file. The race categories used in these projections include: American Indian or Alaska Native, Asian and Pacific Islander, Black, White, and Two or More Races. Hispanic origin is reported separately in these projections and is further categorized as White or non-White within Hispanic or non-Hispanic origin.

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. The CQR correction included a major change in the group quarters population for Durham and Granville County (the population of several prison facilities were incorrectly counted in Granville County rather than Durham County in 2010).

The certified and revised county population estimates produced by the Office of State Budget and Management and released in September 2020 were also used within the projection model.²

² *Certified Estimates of the Total Population of North Carolina Counties for July 1, 2019 and Revised Estimates of the Total Population and Population by Age, Sex, Race, and Hispanic Origin of North Carolina Counties for 2010 through 2018.*

Vital Statistics

The North Carolina State Center for Health Statistics provided vital statistics data for the years 2000 through 2019, which include recorded births and deaths by county of residence. OSBM used the data to calculate mortality and fertility rates and derive estimates of net migration for counties for the 2000 to 2010 period. In addition, preliminary vital statistics by month in 2020 were reviewed to modify mortality and fertility rates to account for COVID-19 for 2020 and 2021.

Group Quarters

Every year, OSBM obtains group quarters population counts for hundreds of facilities within the state from various federal and state agencies, as well as through an annual survey of municipalities and counties. These group quarters include, among other facilities, college and university dormitories, state and federal prisons, military quarters, and nursing homes. Because demographic change for group quarters population do not follow the same pattern as the general population, it is necessary to account for this population by excluding it from the general projection model and then adding it back to obtain the final projections of the total population. For the purposes of producing population projections, OSBM assumed that the group quarters population for each county for all future years remained the same as it was in 2019.³

Assumptions

Population estimates are prepared to approximate the population size and other characteristics of an area for historical periods when no census count of the population is available. Similarly, population projections are prepared to approximate the population size and other characteristics of an area for future periods. Both population estimates and population projections rely on historical data that are symptomatic of population change to approximate historical or predicted future populations, but the population projections also rely on a set of assumptions about the components of population change and the resulting implications for future populations and characteristics of populations. Historical patterns of change in total population or rates of fertility, mortality, and net migration are assumed to continue through the projection period with the exception of 2020 and 2021 – the years impacted by the pandemic. This assumes that the pandemic and the economic fallout will be under control some time in 2021 with full recovery to pre-pandemic conditions in 2022.

Total Population Change

As described above, the forecast model uses historical data to project total population and total population by sex, race, and Hispanic origin through 2050. With the exceptions of the adjustments made to account for the impacts of COVID-19 in the short term, these

³This is based partly on information provided by major sources of groups quarters populations including prisons (North Carolina Sentencing and Policy Advisory Commission), military installations, and college and universities.

projections assume that pre-pandemic trends in population change will continue.

Fertility

The precipitous decline in fertility rates that began during the Great Recession has halted and fertility rates have remained stable, but at a rate much lower than in the 1990s and early 2000s. At the peak in 2007, there were 69.6 births to women aged 15 to 44, which dropped to 58.4 by 2018.⁴ These population projections assume fertility rates remain constant through the projection period, and use a three-year (2017, 2018, and 2019) average of age and race specific fertility rates. The projections also assume a constant distribution of births into male and female for each race group through the projection period equal to the average of the corresponding fractions for calendar years 2009 through 2019.

North Carolina began to experience the impacts of the pandemic in March so that the effects on fertility would not begin to show until the end of 2020. Preliminary statistics on births show a decline in the number of births in the final months of 2020 when compared to previous years. Other states and countries have shown similar trends. The Brookings Institution, using a model to predict births based upon unemployment trends, predicts that US births will decline by 300,000 to 500,000 as a result of the pandemic (or by about 8 to 12%).⁵ Based upon a review of the preliminary data on births by month in 2020, these projections assume a 3% reduction in births relative to last year and 6% decline in fertility for 2021, returning to pre-pandemic age-specific fertility rates in 2022.

Mortality

Following the 2010 Census, OSBM prepared an unabridged lifetable for 2010. With the exception of 2020 and 2021, survival rates obtained from this life table were assumed to remain constant through the projection period with adjustments to the survival rates based upon actual deaths that occurred through 2019. In February 2021, the 10,000th COVID death was recorded. Although 2020 death statistics are incomplete, a review of the preliminary data show trends consistent with those seen in other states and countries – that deaths from all causes will be more for 2020 and 2021 than what we would have expected given the state’s population age structure. At the national level, preliminary estimates have shown a reduction of one year overall in life expectancy at birth as a result of COVID-19.⁶ Review of preliminary, though incomplete, deaths statistics by month provided some guidance on likely trends for 2020 and 2021. Thus, these projections assume higher mortality rates for 2020 and 2021,

⁴ Joyce Martin et al., “Births: Final Data for 2007,” National Vital Statistics Reports (Hyattsville, MD: National Center for Health Statistics, 2010); Joyce Martin et al., “Births: Final Data for 2018,” National Vital Statistics Reports (Hyattsville, MD: National Center for Health Statistics, 2019).

⁵ Melissa S. Kearny and Philip Levine, “Half a Million Fewer Children? The Coming COVID Baby Bust” (Washington, D.C.: Brookings Institute, June 15, 2020), <https://www.brookings.edu/research/half-a-million-fewer-children-the-coming-covid-baby-bust/>.

⁶ Elizabeth Arias, Betzaida Tejada-Vera, and Farida Ahmad, “Provisional Life Expectancy Estimates for January through June, 2020,” National Vital Rapid Release (Hyattsville, MD: National Center for Health Statistics, February 2021).

returning to pre-pandemic levels of age, sex, and race mortality beginning in 2022, when it is expected that the pandemic will be under control.

Net Migration

As previously outlined, the forecast model uses historical data to project total population and total population by sex and race through 2050. Net migration was then derived from a residual between the forecast model and the cohort-component model. To account for the impacts of the global pandemic, an initial model was prepared that did not take the pandemic into account. The resulting derived measure of total net migration provided a reasonable assumption about future levels of net migration based upon recent trends. Then, in addition to the adjustments made to account for changes in mortality and fertility as outline above, total net migration was reduced by 15% for 2020 and 2021. Net migration is difficult to predict when not challenged by the effects of a global pandemic, but international migration was restricted in 2020 and the economic downturn and other factors have so far led to reduction in domestic migration as indicated by surveys and other symptomatic indicators.⁷ This adjustment was based upon the assumption that international migration was reduced to near zero and that domestic migration would continue but at a reduced rate. The latest estimates produced by the Census Bureau indicated that about 27% of North Carolina’s net migration from 2010 and 2019 was attributed to international migration. Beginning in 2022, the model assumes that the level of net migration returns to the previously projected trends – with an increase above that level during 2022 – assuming that some migration was postponed during the pandemic.

Adjustments

Institutional Effects

OSBM modified the basic county trend projections produced for this series to account for change in certain institutions, such as colleges, universities, military installations, and, to a lesser extent, prisons and some state hospitals, house persons of specific age groups. These populations change primarily as a function of administrative action. There are twelve counties in North Carolina with age structures significantly affected by institutions. These counties, and the major institution types that affects them, are: Avery (prisons and college), Craven (military), Cumberland (military), Durham (university), Jackson (university), Madison (university), New Hanover (university), Onslow (military), Orange (university), Pasquotank (university and prisons), Pitt (university), and Watauga (university). OSBM adjusted the projections to account for institutional populations and that the institutional population would stay constant at 2019 levels.

⁷ Cynthia Paez Bowman, “Coronavirus Moving Study: People Left Big Cities, Temporary Moves Spiked In First 6 Months of COVID-19 Pandemic,” January 20, 2021, <https://www.mymove.com/moving/covid-19/coronavirus-moving-trends/>.

Projection Controls

The initial set of population projections projecting total population for 2010 through 2019 were controlled to the independently derived estimates of the total population for counties. The projections were controlled to the revised estimates for 2010 through 2018 and for the certified estimates for 2019.

The estimates and projections of the population by race, sex, and Hispanic origin of each county were then controlled to the estimates and projections of the total population of each county for the estimation/projection period (2010 through 2050).