Carl Vinson
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UNIVERSITY OF GEORGIA

# State of Georgia Population Projections June 2019 Series

Carl Vinson Institute of Government
Applied Demography Program

**A Report Prepared for the Governor's Office of Planning and Budget**

June 2019

# State of Georgia

# Population Projections

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# 1 Executive Summary

A robust state demography program is widely recognized as vital for understanding the characteristics of both the present and future state populations, to inform policy and planning, to direct funding allocation, and to support empirical policy analysis. State and local governments and other stakeholders are focused on the economic, social, political, and environmental consequences of population growth and demographic change. Private sector actors also utilize demographic data in wide-ranging ways, including to guide investment decisions.

State-level demography programs vary considerably in the US, but they all generally involve the preparation of population estimates or projections or both at various geographic levels, and the calculation of such population indicators as fertility rates, life expectancy, and migration patterns. In the State of Georgia, the Governor's Office of Planning and Budget is charged with the responsibility of preparing, maintaining, and furnishing official demographic data for the state (O.C.G.A. § 45-12-171). This current document describes the most recent iteration of state population projections, completed in June of 2019, to provide a foundation for assessing future planning and budgeting.

This round of projections is the first set for which input rates and trends were derived from post-recession data. The previous round of projections relied upon data from the years 2008 to 2012; the calculations for this round use data from the 2013-2017 period. The current projections set thus illuminates fundamental demographic changes and challenges to come. The projections show five primary emerging trends. First, Georgia is expected to see fewer births than necessary to replenish the population going forward, generally referred to in demography as subreplacement fertility rates. Second, the state faces a rapidly aging Baby Boomer generation and higher levels of mortality, which, taken together with reduced births, translates to a lower pace of natural increase. Third, Georgia will consequently need to rely on migration to the state, both domestic and foreign, to fuel positive population growth. Fourth, Georgia is likely to see continuing racial and ethnic diversification, due in part to higher fertility rates among some minority groups and partly stemming from the aforementioned primacy of migration as a component of growth as well as relatively large Hispanic and Asians migration streams. Finally, the state is projected to see a continuation of the long-standing trend toward rural depopulation and urban expansion.

As Georgia continues to grow, the state will experience shifts toward racial and ethnic diversification across all age groups and throughout every county. The diversification will occur against the backdrop of a burgeoning senior population of non-Hispanic whites. The boom in youthful nontraditional minority populations comes as a timely remedy to the aging native population, renewing the workforce and staving off the prospect of population decline. This report presents a detailed methodology of the process by which the June 2019 series of Georgia population projections were made.

## 2 Methodology

Faculty and staff at the University of Georgia's Carl Vinson Institute of Government Applied Demography Program produced projections for the resident population for Georgia and each of its 159 counties for the Georgia Governor's Office of Planning and Budget (OPB).

The Institute of Government developed a stochastic population projection model to incorporate the inherent uncertainty of demographic processes, and to apply expert knowledge to incorporate our understanding of the future direction of underlying trends in fertility, mortality, and migration. This model ran through thousands of iterations, surviving the population forward in five-year intervals, governed by observed statistical parameters, and allowing for the range and pattern of those parameters to vary within established bounds. The median scenario chosen by our model is taken to be the projection of the population. To help elucidate the inherent error in statistical forecasting, we identify a 10% to 90% confidence interval containing 80% of our simulations. Those confidence ranges are available in the datafiles produced by the Institute's projection model.

These projections, like all projections, involve the use of certain assumptions about future events that may or may not occur. Users of these projections should be aware that although the projections have been prepared using established and validated methodologies, input from subject matter experts, and with extensive attempts to account for existing demographic patterns, they may not accurately project the future population of the State of Georgia or of particular counties in the state. These projections should be used only with full awareness of inherent limitations of population projections in general and with specific familiarity with the procedures and assumptions delineated in this methodology statement.

The current projections consist of future count estimates of the resident population of Georgia and of all counties in Georgia for each year from 2018 through 2035, and then for each five-year interval thereafter through 2062. The population is detailed by 18 five-year age cohorts, 0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, and 85 and older, for males and females, in each of four race/ethnic groups: non-Hispanic whites, non-Hispanic blacks, Hispanics of all races, and non-Hispanic Other. The latter category groups individuals who self-identify as Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, multiracial, or unknown race.

This methodology statement details the steps involved in preparing the projections, including the bases and the underlying assumptions.

## 2.1 Cohort Component

The Institute of Government employed a cohort-component technique to project forward the Georgia population. The cohort-component method is among the most widely used techniques in the United States for producing population estimates and projections. Rather than modeling population size, each component of population change — fertility, mortality, and migration — is modeled separately. Current trends in birth rates, death rates, and net migration rates are calculated and applied to a base population via the demographic balancing equation:

$$P_{t_2} = P_{t_1} + B_{t_1-t_2} + D_{t_1-t_2} + M_{t_1-t_2},$$

where:

$P_{t_2}$ = the population at some future date $t_1 - t_2$ years hence,

$P_{t_1}$ = the population at the base year $t_1$,

$B_{t_1-t_2}$ = the number of births that occur during the interval $t_1 - t_2$,

$D_{t_1-t_2}$ = the number of deaths that occur during the interval $t_1 - t_2$,

$M_{t_1-t_2}$ = the net of migration that takes place during the interval $t_1 - t_2$.

When several cohorts are used, $P_{t_2}$ may be seen as:

$$P_{t_2} = \sum_{i=1}^{n} P_{c_i t_2},$$

where:

$P_{t_2}$ is as in the equation above,

$P_{c_i t_2}$ = population of a given cohort at time $t_2$,

$P_{c_i t_2} = P_{c_i t_1-t_2} + B_{c_i t_1-t_2} - D_{c_i t_1-t_2} + M_{c_i t_1-t_2}$,

where all terms are as noted above but are specific to given cohorts $c_i$.

## 2.2 Resident Population

The resident population includes all persons who usually dwell in Georgia. The population is composed of persons for whom Georgia is their "usual place of residence." These include persons in a variety of living quarters such as single-family housing units, multi-unit structures such as duplexes and apartment buildings, nursing homes, military barracks, college residence halls, and correctional facilities. Seasonal and temporary residents are not included.

The following summary provides a detailed description of the stages of development of the projections and the methodologies employed.

## 2.3 Projection Methodology

To develop an appropriate adaptation of the cohort component approach, four major steps were completed:

1. A baseline set of cohorts for the projection area or areas of interest for the baseline time period was selected.
2. Appropriate baseline migration, survival, and fertility measures for each cohort for the baseline time period were determined.
3. A method for projecting trends in fertility, survival, and migration rates over the projection period was determined.
4. A computational procedure was selected for applying the rates to the baseline cohorts to project the population for the period of interest.

### 2.3.1 Baseline Cohorts

The baseline populations for these projections are drawn from years 2013 to 2017 of the US Census Bureaus Population Estimates program, which provides demographic detail on race, age, and sex at the county level for household residents each year. Special populations, also known as group quarters, such as those living in college dormitories, military barracks, or prisons, were based on the recorded count in the 2010 Decennial Census, survived forward to the 2017 launch year through an age-sex-race/ethnicity-based ratio technique, assuming that all age-sex-race/ethnic groups maintained the same proportion in the group quarters and were only affected by overall population growth.

Although it is more common to adopt the previous Census as the baseline year for population projections, since it is a “true” full count, the Institute research team endeavored to capture demographic trends emerging post-recession, necessitating a different approach. Our research revealed that Census estimates, which employ an administrative records based technique, function reasonably well for the state of Georgia. In 2010, the Census Bureau overestimated the state population by a mere 2.0% by the end of the decade [3].

The baseline cohorts are composed of four mutually exclusive groups derived from Census race and ethnic classifications: non-Hispanic white alone, non-Hispanic black or African American alone, Hispanics of any race, and persons in all other non-Hispanic race groups are categorized as non-Hispanic Other.

#### 2.3.2 Cohort Component Rates

**Fertility**

Baseline age-race/ethnicity-specific fertility rates were computed for each county in Georgia and then used to compile total fertility rates (TFR) for each county race/ethnic group. The numerators for the rates were the average birth counts recorded by the Georgia Department of Public Health (DPH) in the 2013-2017 period, whereas the denominators equate to the female household population in 2013 to 2017 in each age group from 10 to 49. Because some populations were sparse for age-sex-race/ethnicity categories in certain counties, we found rates to be unstable and we constrained them within a range of TFR from 1.0 to 3.8. Since 2008, there has been a sharp increase in unrecorded race in Georgia's birth data, an effect associated with the use of the 2003 revision of national birth certificate guidelines (introduced in Georgia in mid-2007). For these cases, we imputed the race/ethnicity of unknown records using multivariate imputation by chained equations (utilizing the R package mice version 3.5.0.). Since the predominant effect of a rise in unknown race births came as an artificial reduction in non-Hispanic white fertility rates, this imputation corrected them higher. The Institute team assumed for purposes of this model that fertility levels will stabilize for the long term at sub-replacement levels and that all groups will converge toward prevailing native non-Hispanic white rates, urban and rural.

**Mortality**

Baseline age-sex-race/ethnicity-specific mortality rates were computed for every county in Georgia. The numerators for the rates were the deaths by age-sex-race/ethnic group in each county, as recorded by DPH. The denominator equated to the total baseline population described above. From these mortality rates, we constructed life tables with standard survival rates and life expectancy. In our projection model, we adjusted future life expectancy targets higher, in line with those projected by the US Census Bureau, gradually increasing projection survival rates above the baseline computed rates. The Institute of Government model utilizes a dynamic approach to mortality, trending life expectancy higher for all race/ethnic groups and sexes, and assuming that they will approximate convergence across the projection horizon.

**Migration**

Net migration rates were computed using a residual methodology for the household population for each sex-age-race/ethnic group in each county. For the 2013 to 2017 period of interest, we added births to the starting population, subtracted all deaths, and determined the net migration rate based on population levels above or below the estimates. Again, due to small population sizes, we encountered unstable rates for certain groups in certain geographies. To address this and to apply our expectation that migration rates would stabilize going forward, we generated migration-rate targets. We separately computed urban and rural state-level net-migration rates and trended future migration rates toward these more stable and generally lower rates. A major assumption of the Institute of Government model is that migration rates will subside and stabilize.

**Urban-Rural**

For all of our rates, we separated rural and urban counties using the US Department of Agriculture's Economic Research Service's 2013 Rural-Urban Continuum Codes. These codes distinguish among metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area. Counties with rural-urban continuum codes of 1 to 3 receive an urban designation; those with codes 4 to 9 are considered rural.

## 2.4 Projection Method

Our projection method relies on a bottom-up approach: County populations were projected and summed to produce a state projection. That projection was then cross-validated with other sources, including independent projections, neighboring state projections, and simple ARIMA methods.

The cohort-component rates described above were applied to a survival matrix in five-year intervals. In each progression, the group quarters population was removed from the resident population to produce a household population, which was survived forward using cohort-component rates, with migration added to the total. The group quarters population was survived separately based on a ratio method, and added back into the population at the end of each step. Because this methodology was insufficient to accommodate the migration patterns of college students, we applied the college fix developed by the US Census Bureau for several counties with large university student populations, removing a fraction of the enrolled population from the household population [4]. This entire process was repeated every five years from 2017 to 2062. This entire model was iterated 4,000 times to produce the most probable median projection scenario, as well as to identify the 10% to 90% confidence interval.

## 2.5 Computation Procedure

The Institute of Government model was developed by demographers and data scientists in the Applied Demography Program. The Institute research team created the model in the R statistical programming language version 3.6.0 (Planting of a Tree) and ran it on R-Studio software version 1.2.1335. Five-year progressive projections were transformed to single-year estimates using linear interpolation after testing determined this would be the most conservative and sound approach.

### 2.6 Limitations

Although the cohort-component model has been exhaustively used and tested throughout the years, it is not infallible. In empirical studies, researchers have noted that the range of error grows substantially the further out in time the projection is. One prominent issue is that smaller-level geographies are inherently difficult to assess in terms of demographic rates, particularly when populations are subdivided by age, sex, and race/ethnic categories. This effect is magnified in areas with small populations. Georgia, hence, presents a special challenge due to its large number of relatively small counties, many of which have small populations. Generating accurate birth and death rates may be compromised by even a small number of births or deaths that are recorded with error or in a separate geography due to the cross-county mobility of residents. Migration flows are notoriously difficult to capture at the county level, and this problem is also exacerbated in smaller counties with smaller populations. A second issue is that the selection of 2013-2017 population estimates may inherit errors from the US Census Bureau estimations program. Despite a reasonable track record at the state level, in rural counties with sparse populations, the estimation program has tended to record larger errors. Finally, although relying upon five-year trends to generate 50-year projections is not uncommon, it is possible that certain temporal population tendencies will be incorporated into the overall model that in fact were only a "blip" in terms of longer-range trends. To address the shortcomings inherent in any population projections, as well as the issues specific to Georgia's unusual geographical structure, painstaking effort was made to evaluate the results in light of expert knowledge and, where possible, to modify the model assumptions to mitigate unusual patterns.

## 3 Bibliography

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