

# POPULATION PROJECTIONS: An Overview of the Methodology

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The Maryland Department of Planning (Planning) produces population and household projections for the state of Maryland and its 24 jurisdictions. The Department's authority to prepare and revise population projections for the State and for each county in the State is described in Annotated Code of Maryland, State Finance and Procurement Article, Division I, [Section 5-306](#). The latest round of projections, published in August 2017, are available to the year 2045. These data are provided at five-year intervals.<sup>1</sup>

Detailed projections (total, household, and group quarters populations) are prepared by age (at five-year cohorts from 0-4 to 80-84 and 85+), sex, and race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other and Hispanic).

A Fortran-based computer model is used to generate total, household, and group quarter population projections for each jurisdiction by age, sex, and race. Model inputs are developed in Microsoft Excel. The final output or reports, which are available in PDF and Excel format, may be accessed at the [Maryland State Data Center](#) web page.

This document is an overview of the data and population change components used to generate the state's population and household projections. The paper highlights data sources, the demographic model, and components of change, i.e., fertility, survival, and migration rates.

## **Primary Data Sources**

*Decennial Census.* The official count of the resident population and housing units is conducted once every ten years by the U.S. Census Bureau. The last Census was completed in 2010.

*Annual Population and Housing Unit Estimates.*<sup>2</sup> Estimates are produced annually by the Census Bureau and reflect the population as of July 1. In the current round of projections, 2015 census estimates serve as the baseline. The estimates or intercensal data, however, is interpolated to reflect population as of April 1.

*Maryland Department of Health.* The Health Department provides birth and death records for each jurisdiction. Fertility and survival rates are derived based on that information.

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<sup>1</sup> The next round of projections would be published in 2020 with data forecast at five-year intervals to 2050. The Maryland Department of Planning reviews its projections annually when adjustments are made as needed.

<sup>2</sup> An estimate is an approximation or best guess of the population based on a sample of the population taken at a specified period when a total count of the population is not available. A Projection, on the other hand, is the expected population for a given area at some future period based on a set of assumptions about future trends.

*Metropolitan Planning Organizations (MPOs)*. Projections from local MPOs— the Metropolitan Washington Council of Governments and the Baltimore Metropolitan Council— serve as a benchmark for Planning’s projections. Planning participates in each MPO’s cooperative forecasting process. To evaluate MPO population projections, Planning breaks the forecasts into their component parts (births, deaths, and migration) for each cohort and moves them forward in time using a standard demographic model.

Note on MPOs: The Cooperative Forecast Committees of the [Metropolitan Washington Council of Governments](#) and the Baltimore Metropolitan Council develop projections based on input from local, state and regional planners. These projections reflect known and expected subdivision activity, local zoning, general and comprehensive plans and, where applicable, capacity constraints. The long-range projections that come out of the MPO cooperative forecasts are generally accepted by Planning. Instances where Planning may modify MPO projections result from different estimates of the near-term population or from alternate assumptions about future growth trends. For counties not taking part in the cooperative forecasts, projections are developed by Planning using a demographic model that incorporates assumptions about fertility, survival, migration, and the group quarters population.

### **Demographic Model**

The cohort-component model is the most widely used projection method in the United States. It has been adopted by 95 percent of all states that produce population forecasts by age, sex, and race. Planning uses the cohort-component model to develop projections for the state’s 24 jurisdictions at five-year intervals by age, sex and race. The model can incorporate many types of data and can be used at almost any geographic level (state, county, subcounty).

The basic population forecast formula is:

Projected Population = Initial Population + (Births - Deaths) + Net Migration

$$P_{t+5} = P_t + ({}^{t+5}B_t - {}^{t+5}D_t) + {}^{t+5}M_t$$

**t = current period**

**t+5= forecast period**

The graphic below shows, in general, the interactions among the components of change in a Cohort-Component model. Cohort-component simply means that population—i.e., household population in Planning’s demographic model— is disaggregated into age-sex-race categories and moved forward in time based on the fertility, survival, and migration trends of each cohort. The graphic illustrates the projection cycle for one cohort over a single five-year period; the cycle must be repeated several times to complete the projection series.<sup>3</sup>

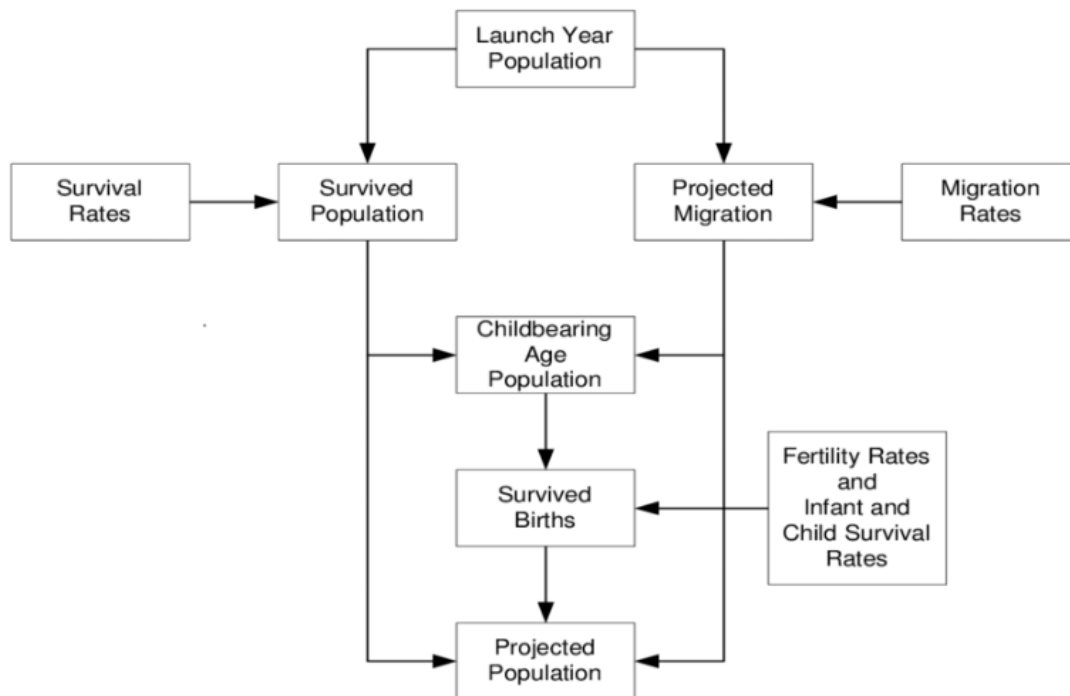


Figure A.1 Overview of the Cohort Component Method

Planning’s model disaggregates household population into four race/ethnic categories (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other, and Hispanic) and 18 five-year age cohorts (from 0-4 years to 85 years and over). These household populations are moved forward 30-years in time at five-year increments. Planning’s most recent projections are from 2015 to 2045.

One limitation with using the cohort-component method is it does not incorporate socioeconomic criteria when developing the fertility, survival, and migration rates which are applied to the different age-sex-race groups. Instead, an analyst starts with the assumption that future rates would be in line with historic patterns. The analyst/demographer may then adjust

<sup>3</sup> See S Smith, J Tayman and D Swanson (2001).

rates based on scenarios that might happen in the future.<sup>4</sup> For example, if one expects longer life spans then survival rates would be increased. The demographic approach followed here does not consider economic factors, such as employment trends and business activity, when building model inputs.

### **Model Inputs**

1. Total and Group Quarters Population by age, race and sex for each jurisdiction.
2. Household Population refers to total population minus the group quarters population that is less than 65 years of age.
3. Fertility Rates (estimated and projected) by age, race and sex for each jurisdiction are prepared at five-year intervals from the base year over the forecast period.
4. Survival Rates (estimated and projected) by age, race and sex for each jurisdiction are prepared at five-year intervals from the base year over the forecast period.
5. Migration rate propensities (i.e., the likelihood to move) by age, race and sex for each jurisdiction are prepared at five-year intervals from base year over forecast period.
6. Group Quarters (GQ) population data is extracted from the Decennial Census. Group Quarters population refers to persons who, under care or custody, stay in a group living arrangement that is managed by or owned by an organization. Group quarter arrangements include correctional facilities (e.g., prisons, detention centers, halfway houses), care facilities (e.g., nursing homes, hospice, residential schools for people with disabilities), student housing, military quarters, and other non-institutional facilities (e.g., homeless shelters, group homes, residential treatment facilities). Note: The GQ population is not projected for each jurisdiction rather a proportion of the statewide GQ projection is distributed across jurisdictions. This proportion is based on a jurisdiction's 2010 share of the state GQ population for each age, sex, and race cohort.

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<sup>4</sup> A demographer's expectations or assumptions may be shaped by published research, by consensus among county and regional planners, by experimental analysis or observation or by other available information.

## **Model Assumptions**

### *Fertility*

Age and race-specific fertility rates are developed for each jurisdiction. An age-specific fertility rate is the number of live births to women of a given age cohort (from 15-19 to 40-44) divided by the total number of women in that age cohort. Fertility rates are also developed based on sex of the baby.

Statistics on live male and live female births by jurisdiction and by the age and race of the mother are provided by the Maryland Department of Health. Data on female household populations come from the Decennial Census and Annual Census Estimates.

Fertility rates are affected by several factors including changes in labor market and socio-economic status. Census data show that fertility rates, across all racial and ethnic groups, have fallen each decade since 1990. Based on such observations, Census researchers speculate that, over a 99-year period, fertility rates would converge for different racial and ethnic groups. Given this outlook, Planning has adjusted fertility rates in its forecast model with the gap between Non-Hispanic White and minority fertility rates narrowing by roughly 35 percent over the projection period.

### *Survival*

Data supporting survival rates come from the Decennial Census, Census Estimates, and the Maryland Department of Health. Survival rates based on two censuses<sup>5</sup> take into account not only deaths but the effects of net migration and census enumeration error as well.

Survival rate, as used in this document, is the probability that an age cohort survives from one period to the next. These rates are developed by age, sex, and race for each jurisdiction at five-year intervals. Multiplying each age-sex-race specific cohort population by its five-year survival rate yields the survived population.

In jurisdictions where the distribution of the non-white population does not meet a minimum threshold, the statewide survival rates for that cohort are substituted for the jurisdiction derived survival rates.

### *Migration*

Migration is the movement of populations across jurisdictions, state boundaries, or international borders to change residence. Net migration is the change in the number of residents in a given geographic area (the difference between those who move into the area and those who move out). This movement may happen for any number of reasons including a

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<sup>5</sup> Hamilton-Perry Method, defined in J. Siegel and D. Swanson (2006)

change in economic conditions, employment opportunities, housing patterns, or transportation issues. For this reason it is difficult to model migration rates. Thus, to calculate migration rates by jurisdiction by age-sex-race cohorts at five-year intervals over the projection period, Planning uses a residual method.<sup>6</sup>

The migration rates are derived by surviving the population (excluding persons in group quarters less than 65 years old) in year one—accounting only for births and deaths—through year five.<sup>7</sup> The result is a closed household population, one in which migration has not occurred. This closed population is then subtracted from the true population count (excluding persons in group quarters less than 65 years old) for year five, as reported in the Census. The difference, which is further broken out by age, sex, and race, becomes the five-year net migration. Next, net migration rates are calculated for that five-year intervals for each age-sex-race cohort. Net migration rates are calculated by dividing the net migration for each group by the closed population for that same group.

### *Group Quarters Population*

Changes in this population are assumed to be related to different factors than those influencing the remainder of the population. For purposes of projections, the group quarters population less than 65 years of age is assumed to be largely related to changes in the overall size as well as age, race and sex distribution of the State's population. Persons in group quarters 65 years and older are treated as household population for purposes of jurisdiction projections. After the household population is projected for each jurisdiction, an estimate of the group quarters population over 65 years of age is developed based on the proportion of group quarters to total population in the 65+ age cohorts as reported in the 2010 Decennial Census.

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<sup>6</sup> S. Becker, Measurement of Migration.

<sup>7</sup> Note that the 2010 – 2015 five-year interval serves as the control for the current round of projections. The fertility rates and survival rates are developed based on the 2010-2015 period and adjusted for succeeding intervals.

## REFERENCES

Becker, S. (2008). *Measurement of Migration*. PowerPoint Presentation. Baltimore: Johns Hopkins University, Bloomberg School of Public Health.

<http://ocw.jhsph.edu/courses/DemographicMethods/PDFs/idm-sec10.pdf>

Colby, S. and J. Ortman (2015). Projections of the Size and Composition of the U.S. Population: 2014 to 2060. Current Population Reports. Washington D.C.: U.S. Census Bureau

<https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf>

Siegel, S. and D. Swanson, Ed., (2004). *The Methods and Materials of Demography*. London: Elsevier Academic Press.

Smith, S., J. Tayman, and D. Swanson (2001). *State and Local Population Projections: Methodology and Analysis*. New York: Academic/Plenum Publishers.

U.S. Census Bureau. *Population Projections, 2017. Methodology and Assumptions*.

<https://www2.census.gov/programs-surveys/popproj/technical-documentation/methodology/methodstatement17.pdf>