Virginia Population Projections Methodology

This methodology document provides an overview of the steps involved in developing population projections for the Commonwealth of Virginia, its 133 localities (95 counties and 38 independent cities), and its large towns (population of 5000 or more) for 2030, 2040, and 2050.

NOTES:

1: Release Timeline for Virginia Population Projections: Due to significant delays in the publication of 2020 Census Data Products by the U.S. Census Bureau, the production and release schedules of projections data products for the Commonwealth of Virginia also had to be accordingly adjusted.

2. Impact of Disclosure Avoidance/Differential Privacy on Census 2020: The U.S. Census Bureau have implemented disclosure avoidance methods which add "statistical noise" – small, random additions or subtractions – to the Demographic and Housing Characteristics File (DHC) data, and this affects the population count input data for small populations and small geographies.

Total Population Projections – Released July 2022

Using the most recently released 2020 Decennial Census count data, and an updated methodology, the July 2022 vintage is the first release of Virginia Population Projections in this decade.

We apply a combination of exponential growth and linear extrapolation methods to derive these projected population totals. The state level totals are developed first, then the individual localities are projected to change based on their past trends and controlled by the state totals.

Input data: Total population at the Virginia state and locality level, from the 2000, 2010, and 2020 Census counts.

Approach for projecting Virginia <u>State</u> total population:

- For 2030, there are 2 scenarios created; a high-growth case and a low-growth case, using 2020 as the launch year. The average of both yields the final projected $\boldsymbol{StatePopulation_{2030}}$.
    - The high-growth scenario applies exponential population growth rate using data from 2010 and 2020.
    - The low-growth scenario applies half of the absolute population change between 2010 and 2020
- For 2040, the absolute population change between 2010 and 2020 is set as the expected growth for the decade, to yield the final projected $\boldsymbol{StatePopulation_{2040}}$.
- For 2050, the annualized growth between 2000 and 2020 is calculated and linear extrapolation is applied to the 2040 projections to construct the final projected $\boldsymbol{StatePopulation_{2050}}$.
- Projections for 2035 and 2045 are interpolated, and those for 2055 are extrapolated from the end-of-decade projected populations.

Approach for projecting Virginia <u>Locality</u> total population:

- For 2030, the localities are initially projected to grow by their individual absolute population change between 2010 and 2020. The final locality level population projection for 2030 is set by redistributing the state control total to yield $\boldsymbol{LocalityPopulation_{2030}}$.
- For 2040 and 2050, the localities are initially projected to grow by their individual annualized growth between 2000 and 2020. The final locality level population projections is set by redistributing the state control totals for 2040 and 2050 to yield $\boldsymbol{LocalityPopulation_{2040}}$ and $\boldsymbol{LocalityPopulation_{2050}}$.
- For mid-decade time points, projections for 2035 and 2045 are interpolated, and those for 2055 are extrapolated from the end-of-decade projected populations.

Approach for projecting Virginia <u>Town</u> total population:

- Projections are constructed for Virginia towns with a population total over 5000 as per the latest 2020 Census count.
- The ratios of town population to parent-county population is used to create their respective shares and project the 2030, 2040, and 2050 for large towns in Virginia.

Age and Sex Population Projections – Released August 2023

The Virginia Population Projections by demographic characteristics, such as by age-group and sex were developed after the U.S. Census Bureau released their Demographic Profile and Demographic and Housing Characteristics File (DHC) in May 2023, which contain the 2020 Census data by five-year age-group and by sex that are required to build the new Virginia projections.

Input data: Population total, by age, by sex, at the Virginia state and locality level, from the 2000, 2010, and 2020 Census counts.

Approach for projecting Virginia State and Locality population by Age:

Benchmarked on the 2020 Census data, age distribution for each locality is constructed using the Hamilton-Perry cohort-component method.

- Generating CPRs (child population ratio) and CCRs (cohort change ratio) for every age cohort within each locality, using data from 2000, 2010, and 2020.

For cohorts 0-4 and 5-9, CPRs capture the birth rates in the prior decades. We divide the child population by the appropriate population of child-bearing age to generate the CPRs.

$$CPR_{0-4}^{2000-2010} = \frac{LocalityPopulation_{0-4}^{2010}}{LocalityPopulation_{15-44}^{2010}} \quad \& \quad CPR_{0-4}^{2010-2020} = \frac{LocalityPopulation_{0-4}^{2020}}{LocalityPopulation_{15-44}^{2020}}$$

$$CPR_{5-9}^{2000-2010} = \frac{LocalityPopulation_{5-9}^{2010}}{LocalityPopulation_{20-49}^{2010}} \quad \& \quad CPR_{5-9}^{2010-2020} = \frac{LocalityPopulation_{5-9}^{2020}}{LocalityPopulation_{20-49}^{2020}}$$

For cohorts 10-14, …. 80-84, 85+, CCRs measure the combined effects of deaths and migration. We use the ratio of population in an age-group (a) in one decade, to the population in age-group (a-10) in the previous decade, to calculate CCRs.

$$CCR_{Age\ Cohort}^{2000-2010} = \frac{LocalityPopulation_{Age\ Cohort}^{2010}}{LocalityPopulation_{Age\ Cohort-10}^{2000}} \quad \& \quad CCR_{Age\ Cohort}^{2010-2020} = \frac{LocalityPopulation_{Age\ Cohort}^{2020}}{LocalityPopulation_{Age\ Cohort-10}^{2010}}$$

To smooth out fluctuations, we use averaged CCR and CPR values over 2000-2010 and 2010-2020.

$$\overline{CPR}_{Age\ Cohort} = \frac{CPR_{Age\ Cohort}^{2000-2010} + CPR_{Age\ Cohort}^{2010-2020}}{2} \quad \& \quad \overline{CCR}_{Age\ Cohort} = \frac{CCR_{Age\ Cohort}^{2000-2010} + CCR_{Age\ Cohort}^{2010-2020}}{2}$$

- Calculating the projected locality population by age for 2030 from Hamilton-Perry age forwarding, using population data from 2020 as the launch year and locality specific average CPRs or CCRs over 2000-2010 and 2010-2020.

$$LocalityPopulationHP^{2030}_{Age\ Cohort} \cong \overline{CPR}_{Age\ Cohort} * LocalityPopulation^{2020}_{Age\ Cohort-10}$$

$$LocalityPopulationHP^{2030}_{Age\ Cohort} \cong \overline{CCR}_{Age\ Cohort} * LocalityPopulation^{2020}_{Age\ Cohort-10}$$

Now the total population of the locality for 2030 from Hamilton-Perry method can be calculated by summing across all age cohorts,

$$LocalityPopulationHP_{2030} = \sum_{Age\ Cohorts} LocPopulationHP^{2030}_{Age\ Cohort}$$

- Calculating the locality's population for 2030 for each age interval, by redistributing the total population for 2030 as per the age distribution from Hamilton-Perry method.

$$\boldsymbol{LocalityPopulation^{2030}_{Age\ Cohort}} = \frac{LocalityPopulationHP^{2030}_{Age\ Cohort}}{LocalityPopulationHP_{2030}} * LocalityPopulation_{2030}$$

- Calculating the projected state population for 2030 by each age cohort, from summing the projected locality populations for 2030 by each age cohort.

$$\boldsymbol{VAPopulation^{2030}_{Age\ Cohort}} = \sum_{Locality} LocalityPopulation^{2030}_{Age\ Cohort}$$

This yields the projected age distribution for Virginia's overall population in 2030.

- The process is repeated for 2040 and 2050 by applying the Hamilton Perry age forwarding to the locality population in the immediately preceding decade, and using this age distribution to redistribute the previously calculated locality total projections.
- The state projected population for Virginia by age for 2040 and 2050 is similarly calculated by summing over the projected age categories across all the localities.

Approach for projecting Virginia State and Locality population by Sex:

Projections by sex are determined by maintaining the population's age-specific sex-ratio as per the 2020 Census. Since sex-ratios are historically stable, this ensures that localities with unique sex-distribution (prisons, military barracks etc.) can retain their characteristics. The sex-ratio is applied to the projected population in each age cohort within each locality, for 2030, 2040 and 2050. The male and female population groups within each age cohort are then summed across all the localities, to get the population projections by sex for Virginia as a whole.