Maine Population Outlook to 2034 Methodology
Governor's Office of Policy and Management
November 2016

The Office of Policy and Management has prepared population projections for counties and the state of Maine. Populations are projected for 2019 through 2034 in five-year intervals and are given for five-year age cohorts by sex.

It is important to note that the projections presented here are not exact. Any estimation errors in recent population estimates will be incorporated into future projections. The county-level model assumes that past birth, death and migration rates within each cohort will persist into the foreseeable future. The model cannot account for unprecedented future events that may dramatically alter a county's demographic composition, such as future military base closings; large factory openings and closures; or changes in technologies, personal choices, or environmental conditions in the next 20 years that may alter migration behavior or birth and death rates. As such, population projections are more accurate for the near future than distant years and should be updated regularly.

Methodology
The county projections are the basis for the state projections. The methodology used for the county projections is the cohort-component method. This widely-used methodology utilizes births, deaths, and migrations to advance each age-sex cohort through the projection period. It allows for specific survival and migration rates to be calculated for each age-sex cohort. Using this methodology provides a detailed projection of the county population.

As with any projections, these are only an estimate of one possible scenario. While the best data and methodology available at the time are used, there are many factors that could change the projections. These projections are based on past trends of birth, survival, and migration rates. The projections do not take into account any future changes in these rates. In addition, life expectancy is held constant during the time period.

The population is divided into 18 age cohorts: 17 five-year cohorts, beginning with 0-4 and continuing through 80-84, and one open-ended cohort, 85+. When divided among males and females, this gives a total of 36 age-sex cohorts. Because the cohorts are in five-year intervals, it is necessary to advance the projections five years at a time. The population of 20-24 year olds in 2014 will be 25-29 in 2019. These projections go out to 2034, for four projection data points (2019, 2024, 2029, and 2034).

There were three key inputs to the county projections: the number of births by the age of the mother for each year from 2010 to 2014, the number of deaths by age and sex for each year from 2010 to 2014, and the population estimate by age and sex as of July 1 of each year from 2010 to 2014. The births and deaths data came from the Office of Data, Research, and Vital Statistics in the Maine Department of Health and Human Services while the population estimates came from the U.S. Census Bureau. Additional data came from the U.S. Census Bureau's American Community Survey and national population projections.

The operational birth rate for females in each age cohort is calculated as the five-year average birth rate from 2010-2014, multiplied by five and averaged between the current and the next age cohort. The averaging over two cohorts is done because the average female can expect to spend half of the next five years in her current age cohort and half of the next five years in the next age cohort. For example, the operational birth rate for 25-29 year olds is the average of the 25-29 five-year rate and the 30-34 five-year rate. For 15-19 year olds and 20-24 year olds (the traditional college age population), those living in college/university group quarters are excluded from these calculations as the birth rates for college students living in dorms are considerably lower than birth rates for the general population.

Operational survival rates are calculated for each age-sex cohort. The average survival rate for each cohort is calculated as the average number of deaths from 2010 to 2014 divided by the 2012 cohort population and then subtracted from one. To get the five-year rate, the average survival rate is raised to the fifth power: mortality being a permanent condition, the probability of surviving more than one year compounds exponentially. As with the birth rates, survival rates are averaged across the current and the subsequent age cohorts. For example, the operational survival rate for 65-69 year olds is the 65-69 five-year rate raised to the 0.5 power multiplied by the 70-74 five-year rate raised to the 0.5 power.

The oldest and youngest age cohorts are treated somewhat differently. For the youngest age cohort, 0-4 year olds, the operational survival rate is simply the one-year survival rate raised to the 2.5 power. For the oldest age cohort, 85 and older, the operational survival rate is simply the five-year survival rate because there is no further age cohort for them to age into.

Migration is the most complicated element of the projections. Out-migration and in-migration are calculated separately and applied to different populations to obtain the migration rates.

The out-migration and in-migration rates use the 2014 5-year estimates of movers to and from counties produced by the U.S. Census Bureau as part of the American Community Survey. For each cohort, the total preliminary number of out-migrants is divided by the estimated total number living in the county one year ago. This is the preliminary out-migration rate. The 2014 total population of each age cohort is multiplied by the preliminary out-migration rate to get the estimated number of out-migrants for each cohort. Finally, this number is multiplied by the percentage of total out-migrants that were male and female to get the estimated number of out-migrants for each age-sex cohort.

The preliminary in-migration rate is calculated by dividing the total preliminary number of in-migrants by the estimated total number currently living in the county for each age cohort. As with out-migration, the 2014 population of each cohort is multiplied by the preliminary in-migration rate to get the total estimated in-migrants for each age cohort. This number is multiplied by the percentage of total in-migrants that were male and female to get the estimated number of in-migrants by age and sex.

Next, the survived population at risk of migration is calculated by subtracting from the 2012 cohort population the number of in-migrants and adding the number of out-migrants. Then the out-migration rate is calculated by dividing the number of out-migrants by the survived population at risk.

Since the entire U.S. population is at risk of in-migration, it is necessary to begin with the 2014 cohort population for the U.S. to calculate in-migration. From this is subtracted the survived population at risk for the county (since they were already living in the county, they cannot be at risk of moving into the county). The number of in-migrants is divided by the rest-of-nation population at risk to get the in-migration rate.

The survived population for 2019 is calculated by multiplying the 2014 population for each cohort by the corresponding operational survival rate. The stayers in county are calculated by multiplying the survived population by one minus the out-migration rate. The number of out-migrants is calculated by subtracting the stayers in county 2014-2019 from the survived population for 2019.

Next the 2019 survived population is subtracted from the 2019 cohort population from the U.S. Census Bureau's national population projections. This is multiplied by the in-migration rate to get the number of in-migrants. The 2019 population is calculated by adding the number of in-migrants to the stayers in county 2014-2019. Keep in mind that this is the population of the next age cohort for 2019. People who were 20-24 in 2014 are 25-29 in 2019.

The college/university group quarters population is, generally speaking, a static population – unless a college or university significantly changes its living-on-campus enrollment from one year to the next, the number of college/university students stays approximately the same. For this reason, the college/university group quarters population is removed from the calculations at the beginning of the process and added back in at the end of each forecast year. In other words, this particular cohort does not continue through the aging process the same way that the general population does.

For the oldest cohort, the calculated 2019 population is added together for the oldest and next-oldest age cohorts. The 85+ cohort contains those who were 85+ in the previous period as well as those who were 80-84 and have aged into the 85+ cohort.

The youngest cohort, those born during the 5-year period, is more complicated to project. The 2019 survived female population is subtracted from the 2014 female population to get the number of deaths in each cohort. The population at risk of giving birth is calculated by adding the stayers in county 2014-2019 to the in-migrants and half of the deaths

during the period. This figure is multiplied by the operational birth rate to get the number of births. All the births across the cohorts are added and multiplied by the average percentage of the population that is female/male to get the number of female/male births. Each of these is multiplied by the respective operational survival rates to get the 2019 0-4 cohort population. Note that migration is addressed through the mothers' movements.

State-level projections were obtained by adding together the county projections.

City and town population projections are calculated using two pieces of information:

1. The recent historical growth of each town's share of its county's population and
2. County population projections.

The projections use linear regression analysis to estimate a constant rate of growth for each town's share of their county population between 2010 and 2014. This growth rate is then extrapolated into the future, using county population projections to project the population for each town in 2019, 2024, 2029, and 2034.

This method produces some results that may seem counterintuitive. For example, some towns may be projected to shrink between 2014 and 2019, even though they showed historical population growth and the county is expected to grow from 2014 to 2019. Keep in mind that the population projections for the town are based on changes in its share of the county's population. The town's share of the county population may be declining even though the town and the county have both been growing in population. The town population projections thus rest on the assumption (among many others, including those upon which the county population projections are based) that relative growth rates of towns in a given county will continue into the future.