Introduction

This report provides a technical description of the November 1, 2012 population projections for the state of Connecticut. Population projections were prepared for each of the 169 towns, each of the 8 counties, each of 14 regional planning organizations and the state as a whole. The projection for each geography was developed separately, and for each of the 8 counties, each of the 14 regional planning organizations, and state, the life table and fertility rate based on the death and birth data are constructed separately for each unit. For example, there are 8 different life tables and fertility rates for the 8 counties in Connecticut. The towns are divided into three categories based on the American Community Survey data as shown in the following table.

ACS 1-year Towns	Bridgeport, Danbury, Hartford, New Britain, New Haven, Norwalk, Stamford, Waterbury
ACS 3-year Towns	Darien, Fairfield, Greenwich, New Canaan, Newtown, Ridgefield, Shelton, Stratford, Trumbull, Westport, Berlin, Bloomfield, Bristol, East Hartford, Enfield, Farmington, Glastonbury, Manchester, Newington, Simsbury, Southington, South Windsor, West Hartford, Wethersfield, Windsor, New Milford, Torrington, Watertown, Middletown, Branford, Cheshire, East Haven, Guilford, Hamden, Meriden, Milford, Naugatuck, North Haven, Wallingford, West Haven, Groton, New London, Norwich, Mansfield, Vernon, Windham
ACS 5-year Towns	Bethel, Brookfield, Easton, Monroe, New Fairfield, Redding, Sherman, Weston, Wilton, Avon, Burlington, Canton, East Granby, East Windsor, Granby, Hartland, Marlborough, Plainville, Rocky Hill, Suffield, Windsor Locks, Barkhamsted, Bethlehem, Bridgewater, Canaan, Colebrook, Cornwall, Goshen, Harwinton, Kent, Litchfield, Morris, New Hartford, Norfolk, North Canaan, Plymouth, Roxbury, Salisbury, Sharon, Thomaston, Warren, Washington, Winchester, Woodbury, Chester, Clinton, Cromwell, Deep River, Durham, East Haddam, East Hampton, Essex, Haddam, Killingworth, Middlefield, Old Saybrook, Portland, Westbrook, Ansonia, Beacon Falls, Bethany, Derby, Madison, Middlebury, North Branford, Orange, Oxford, Prospect, Seymour, Southbury, Wolcott, Woodbridge, Bozrah, Colchester, East Lyme, Franklin, Griswold, Lebanon, Ledyard, Lisbon, Lyme, Montville, North Stonington, Old Lyme, Preston, Salem, Sprague, Stonington, Voluntown, Waterford, Andover, Bolton, Columbia, Coventry, Ellington, Hebron, Somers, Stafford, Tolland, Union, Willington, Ashford, Brooklyn, Canterbury, Chaplin, Eastford, Hampton, Killingly, Plainfield, Pomfret, Putnam, Scotland, Sterling, Thompson, Woodstock

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ACS 1-year towns include the towns for which ACS 1-year data are reported. ACS 3-year towns include the towns for which ACS 3-year data are reported and excluded those towns already included in the ACS 1 year towns. ACS 5-year towns include the remaining towns not included in the ACS 1-year or ACS 3-year towns. The population sizes of ACS 1-year towns, each town includes over 65,000 individuals, are large enough to construct their own life table. All ACS 3-year towns are grouped together to construct the common life table for these towns, and the same procedure are done for the ACS 5-year towns. Actual birth and death data for the years 2000-2010 were provided by the Connecticut Department of Public Health at town level.

The projection begins in the year 2010 with the single year age/sex distribution of the Connecticut population as reported in the U.S. Census. The calculations are based on the standard cohort-component projection modified to produce a single-year projection. Essentially, the cohort component method involves calculating the future size of cohorts, taking into account the effects of fertility, mortality and migration. The forecast proceed by single years of age and these single years are then combined into 5 year cohorts. Each year a new birth cohort is forecasted by applying fertility rates to the appropriate female population. The forecast ends in the year 2025. The finalized data of this projection are provided on the Connecticut State Data Center website follow the standard format of five-year age group carried over five-year projection periods by aggregating the single year age projection data. The five-year age groups begin with the 0-4 age group and extend through 85-89, with the final age group including all individuals 90 years and over.

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Births and Fertility Rates

The age-specific fertility rates (ASFRs) for single years of age were calculated by using actual birth in 2010 as the numerator with the associated 2010 census female population as the denominator. There were 56 single-year ASFRs calculated for the 56 childbearing cohorts between ages of 10 to 65.

$$ASFR_x = \frac{number\ of\ births\ in\ 2010\ to\ women\ in\ age\ x}{2010\ census\ population\ of\ women\ in\ age\ x}$$

The fertility rates are applied to the number of women aged between 10 and 65, and repeated throughout the entire projection period with the assumption that the fertility rates in Connecticut will be constant over the next 15 years. Variations in the number of births occur as the number of women in the childbearing cohorts changes. Applying the ASFRs generates estimates of the number of children born within the projection year. However, in order to get the number of male births and the number of female births for each projection year, the sex ratio at birth (the number of male births per 100 female births) need to be calculated as follows:

$$Sex\ Ratio = \frac{number\ of\ male\ births}{number\ of\ female\ births} \times 100$$

After the ASFRs and sex ratio at birth have been applied, the projected number of new male births and female births are placed into the appropriate 0 age cohort for each projection geography zone. Then survival and migration rates are applied to this 0 age cohort.

$$Male\ Birth = \frac{Sex\ Ratio}{Sex\ Ratio + 100} \times \sum_{x=10}^{65} (W_x \times ASFR_x)$$

$$Female\ Birth = \frac{100}{Sex\ Ratio + 100} \times \sum_{x=10}^{65} (W_x \times ASFR_x)$$

where W_x is the average number of reproductive female aged x during the projection year.

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However, many Connecticut towns, namely the ACS 3-year towns and ACS5-year towns, are too small to satisfy the requirement of a population base sample of 100,000 or more in size to generate of statistically reliable birth rates. For this reason, the small towns were grouped together according to the groupings that Census Bureau used in providing town level data from the ACS. The same grouping process was used to construct life tables and thus for the survival rates.

Another adjustment was made for each geography unit where persons in group quarters account for a sizeable share of total population. The main components of group quarter people are noninstitutionalized population, which can be college/university study housing or military quarters and institutionalized population. Thus people in the group quarters tend to have lower fertility rates. Also these people will affect the migration and survival rate during the projection, so, as described below in more detail, populations in the group quarters were selected out and held constant according to each cohort.

Death and Survival Rates

The single year survival ratios were calculated by constructing complete life tables using death data provided by the Connecticut Department of Public Health along with the 2010 census population. Unique life table was built for state and each county, regional planning office, ACS 1-year town. And all ACS 3-year towns share one life table that based on all death data of all these towns. And so does ACS 5-year towns. The survival ratios were derived from the average number alive between exact ages (L_x) in the life table as follows:

$$S_x = \frac{L_{x+1}}{L_x}$$

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where S_x is the survival ratio for age x. For a final open-ended interval, such as from age 89+ to 90+, the survival ratio calculated as:

$$S_x = \frac{T_{x+1}}{T_x}$$

where T_x is the total population age x and over, which is also included in the life table. While the survival ratio of birth is also calculated separately as follows:

$$S_0 = \frac{L_0}{l_0}$$

where l_0 is the number alive at exact age zero, which is also known as *radix* of the life table. 100,000 is the most common radix, 1,000 or 10,000 are alternatives.

A set of survival ratios for migrants (S_x^m) is also calculated based on the previous survival ratio using the formula as follows:

$$S_x^m = \frac{1 + S_x}{2}$$

The calculation assumes that, on average, migrants are present in the destination for half the interval. All the migrants are alive at the middle of the interval, after which they are subject to the mortality of the receiving population.

Migration

Age-sex specific net migration for the state, each county, each regional planning office, and each town was calculated using the forward survival ratio method. The forward survival ratio methods of estimating net migration entail two main steps, as illustrated in the figure below.

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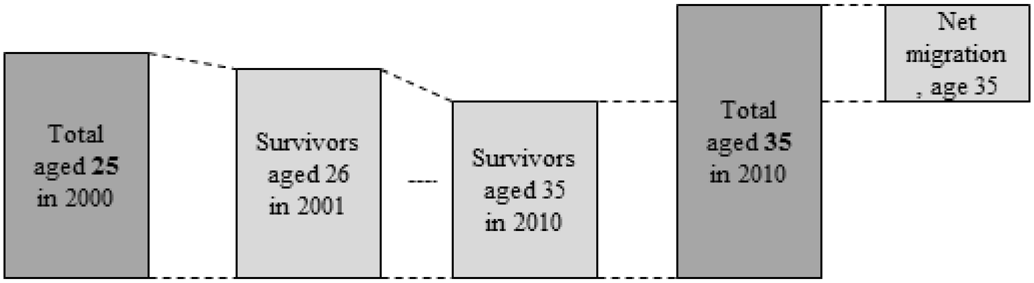

First, calculate how many populations in one cohort survive from one census (2000 census) to the next (2010 census). Second, subtract the number of survivors from the cohort's observed size at the second census. The difference is assumed to be net migration occurred during this period. These calculation were made for each cohort and separately for males and females, on account of age and sex related variations in probabilities of moving. The single year survival ratios were calculated by constructing complete life tables using death data provided by the Connecticut State Department of Public Health along with the 2000 census population as the method talked previously. The male and female births for every year from 2000 to 2010 are filled in directly using the birth data from the Connecticut State Department of Public Health. The annual age-sex specific net migration is derived by dividing the age-sex specific intercensal net migration by 10. This derived annual age-sex specific migration was then considered as the model for future migration for the projection period 2010 to 2025. The group quarter population in 2000 and 2010 census, which will be further discussed in the next session, were removed during the net migration calculation.

Group Quarter Population

For the most part, group quarter institutions have populations that do not change their demographic character over time. Therefore, group quarter populations that account for a sizeable share of the total population in each geography unit were held constant according to age

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-sex cohort during the whole projection procedure. In order to achieve this, the first step is to get the single year age population data for each group quarter. However these data could hardly be available publicly. So we reduce the constraint that select tract that contains that group quarter as tract is the smallest reported unit by Census Bureau that contains the single year age data. Then aggregate all these type of populations to be held constant by towns, county, and regional planning office. Before the proceeding of the projection procedure, these selected group quarter data were subtract from the base population before any survival or migration rates were applied. After these rates were applied to the adjusted population, the selected populations were added back to form the final projection data. The following table provides a listing of the number of population held constant by census tract and their associate town.

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Town Name	Group Quarter Name	Group Quarter Population	Tract ID	Tract population
Cheshire	Cheshire & J.R. Manson Correctional Institutions	2120	09009343101	5810
Danbury	Federal Correctional Institutions	1339	09001211100	1375
East Lyme	Gates & Niantic Correctional Institutions	2106	09011716101	6109
Enfield	Enfield Correctional Institutions	3377	09003524300	7291
Fairfield	Sacred Heart University with adjacent housing	1459	09001060100	4152
Fairfield	Fairfield University with adjacent housing	2686	09001060700	7675
Groton	Naval Submarine Base New London	2091	09011980000	2097
Hamden	Quinnipiac College with adjacent housing	3288	09009166002	7726
Hartford	Hartford Correctional Institutions	1095	09003500700	1095
Hartford	Trinity College with adjacent housing	1888	09003502700	5240
Hartford	University of Hartford with adjacent housing	2702	09003503800	3508
Mansfield	Northeast Correctional Institutions	2197	09013881300	6189
Mansfield	University of Connecticut with adjacent housing	9953	09013881200	10289
Middletown	Wesleyan College with adjacent housing	1767	09007541500	3227
Montville	Radgowski Correctional Institutions	1532	09011870502	3632
New Britain	Central Connecticut State University with adjacent housing	2114	09003417300	2150
New Haven	Southern Connecticut State University with adjacent housing	2340	09009141300	5913
New Haven	Yale University with adjacent housing	2542	09009361401	4933
New Haven	Yale University with adjacent housing	3019	09009361402	3367
New London	U.S. Coast Guard Academy	2699	09011870300	6662
Somers	Somers Correctional Institutions	2339	09013538100	2339
Suffield	MacDougall-Walker Correctional Institution	2516	09003477102	8521
West Haven	University of New Haven with adjacent housing	2508	09009361500	7607
Windham	Eastern Connecticut State University with adjacent housing	2635	09015800300	6430

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