Population Projections by Age, Disability and Income Level for Vermont in 2020 and 2030

Technical Appendix

Overview

The Vermont Department of Disabilities, Aging and Independent Living (DAIL) engaged the University of Massachusetts Medical School (UMMS) to produce projections of Vermont residents. This databook provides population projections for the state of Vermont and its fourteen counties by age, disability and income level (by Federal Poverty Level, FPL). In addition, this databook provides population projections for the state of Vermont by age and disability; by age and income (by FPL); and by age, income (by FPL) and disability.

Estimates represent the projected number of individuals in 2020 and 2030. All projections presented in this databook assume that the proportion of individuals in each category remains constant between the baseline period (2009-2013) and the future years. That is, we applied current rates of disability, poverty, etc., using ACS data (2009-2013), to projected population counts produced by Jones and Schwartz (2013). We present population projections for two scenarios, A and B (see further details below).

Data Sources

1. **Baseline data for age, disability and income level: American Community Survey (ACS)**

We used ACS 2009-2013 five-year estimates for age, disability status, income level, and their intersection, as baseline data for the state of Vermont and its counties. We used both publicly available data tables S2701, B17001 and B17020, as well as custom data tables obtained from the U.S. Census Bureau. Data for current estimates are presented in the Current Demographics databook that accompanies this databook. Data tables used from the Current Demographics workbook are referenced in the Table of Contents and in the 'Data source' field above each projection table.

Publicly available ACS data were downloaded from the U.S. Census Bureau's FactFinder:

https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

2. **Population sizes in 2020 and 2030: Jones and Schwartz (2013)**

We used the projected number of individuals by age group, for the state of Vermont and its counties, produced by the Vermont Agency of Commerce and Community Development (Jones and Schwartz, 2013). We project population sizes under two sets of assumptions developed by Jones & Schwartz (2013): Scenario A assumes a stronger economy and a higher rate of migration, while Scenario B assumes a weaker economy and a lower rate of migration (Jones and Schwartz, 2013). To date, actual population growth in Vermont has tracked closer to Scenario B (personal communication with Joyce Manchester, Senior Economist at the Vermont Legislative Joint Fiscal Office, November 2016).

This report is available to download at:

http://dail.vermont.gov/dail-publications/publications-general-reports/vt-population-projections-2010-2030

Disability categories

UMMS requested data for custom disability categories from the U.S. Census Bureau, to better meet the service planning needs of the Vermont Department of Aging and Independent Living (DAIL). In order to approximate the population needing long-term services and supports (LTSS), the 'Functional Difficulty' category was constructed to include those individuals needing assistance with mobility or self-care, i.e. those identified in the ACS as having 'ambulatory difficulty,' 'self-care difficulty' and/or 'independent living difficulty.' This definition was employed in "Securing the Future," a report for the Massachusetts Long-Term Care Financing Committee (referenced below).

Our custom disability categories were constructed using the following ACS questions:

> **Cognitive Difficulty:** ""Because of a physical, mental, or emotional condition, does this person have serious difficulty concentrating, remembering, or making decisions?"" (DREM; ACS survey question #18a)
>
> **Functional Difficulty:**
>
> ""Does this person have serious difficulty walking or climbing stairs?"" (DPHY, ACS question #18b)
>
> and/or ""Does this person have difficulty dressing or bathing?"" (DDRS, ACS question #18c)
>
> and/or ""Because of a physical, mental, or emotional condition, does this person have difficulty doing errands alone such as visiting a doctor's office or shopping?"" (DOUT, ACS question #19)

The 'Cognitive Difficulty' question (18a) and two of three 'Functional Difficulty' questions (18b and 18c) were asked of individuals aged 5 years and older, and the third 'Functional Difficulty' question (19) was asked of individuals aged 15 years and older.

The resulting questions were grouped as follows, into the following categories:

> Cognitive Difficulty only - individuals with DREM only (but not a functional difficulty, response 'no' to DDRS, DPHY and DOUT)
>
> Functional Difficulty only - individuals with DDRS, DPHY or DOUT (any of these; at least one), but no cognitive difficulty (response 'no' to cognitive difficulty, DREM)
>
> Both a Functional and Cognitive Difficulty - Individuals with any of DDRS, DPHY, DOUT or DREM
>
> Neither a Functional or Cognitive Difficulty - Individuals who do not have any of DDRS, DPHY, DOUT or DREM (these individuals could have hearing or vision difficulties).

Our custom ACS disability definition maps closely, although not exactly, to other age-specific measures of disability. Specifically, compared to Manton and colleagues (2006), our custom, ACS-based definition of 'Functional disability' captures a higher portion of the elder population. Manton and colleagues (2006) grouped elders based on need for assistance with Instrumental Activities of Daily Living (IADL) and Activities of Daily Living (ADLs). In an analysis of the Massachusetts population, the 'Functional

disability' indicator estimated that one-third of the elder population needed LTSS, compared with only 19% identified as needing assistance with ADLS or IADLs in the Manton study.

Approach

The estimates presented in this databook were based on projected population sizes by age group developed by Jones and Schwartz (2013) for all Vermont counties and statewide, in 2020 and 2030, to which we applied current population rates in a given demographic category.

Assumptions: As stated earlier, all projections presented in this databook assume that the proportion of individuals in each category remains constant between the baseline period (2009-2013) and the projected years (2020 and 2030). This is also known as the 'constant-share' method (see further details Smith et al., 2013).

We chose not to incorporate published trends in our projections, because we found variability in the directionality (increase or decrease in rates) and magnitude of the projected change (how large the future increase or decrease is estimated to be). Moreover, published projections have been developed for people with specific disease conditions and for other regions, states or the nation; these populations may or may not be representative of the Vermont population. Because of the variability of these projections and concerns about their applicability to Vermont, we did not incorporate trends other than population trends in our projections. References to research published by other groups are included under 'Suggestions for further reading' in the accompanying slide deck.

Calculations: We calculated the proportion of individuals in each category ('current population rates'), based on American Community Survey (ACS) five-year estimates for 2009-2013. Current population rates were calculated as a simple ratio between the number of individuals in each category, divided by the total number of individuals in the state or county, or in each age group, in each state or county. Below, we demonstrate how current population rates were calculated for each category, showing numerators and denominators, together with the applicable projected population size (or "multiplier") from Jones and Schwartz:

1. **Age:** 0-17, 18-64, 65 and older, and 65-69, 70-74, 75-79, 80-84 and 80 and older

   Data source: Jones and Schwartz (2013)

   NOTE: Data represent numbers of individuals projected by Jones and Schwartz (2013). We calculated the number of individuals in age categories 0-17, 18-64, 65 and older, by summing numbers of individuals presented in each five-year incremental age category, as published by Jones and Schwartz (2013) for the 2010 base year as well as the projected years 2020 and 2030:

0-17 years:	Sum of <5, 5-9, 10-14, and three-fifths of 15-19 year-olds
18-64 years:	Total population, less individuals aged 0-17 years (summation shown above) and individuals aged 65 years and older, plus two-fifths of 15-19 year-olds
65 years and older:	Sum of 65-69, 70-74, 75-79, 80-84 and 80 years and older

2. **Disability:** Cognitive difficulty, functional difficulty, cognitive and functional difficulty, neither difficulty

    Data source: Current Demographics table A3 (custom ACS data)

    Current population rate calculated as:

    Numerator: Number of individuals in disability category
    Denominator: Total population in county or state of Vermont for whom the ACS determines disabilities

    NOTE: The ACS reports disabilities for individuals aged 5 years and older or for individuals aged 15 years and older.

    Projected number of individuals in each disability category in 2020 and 2030: Current population rate (above) for each disability category, multiplied by the total population age 5 years and older in 2020/2030 (calculated as the total population less number of individuals less than 5 years old) as projected by Jones and Schwartz (2013).

3. **Income (federal poverty level, FPL):** Below 138% FPL, 138-199% FPL and ≥ 200% FPL

    Data source: Current Demographics table A4 (publicly-available ACS data table S2701)

    Current population rate calculated as:

    Numerator: Number of individuals at each income level
    Denominator: Total population in county or state of Vermont for whom income was determined

    Definition of Poverty: These projections reflect U.S. Department of Health and Human Services Poverty Guidelines, rather than U.S. Census Bureau Poverty Thresholds. More information is available at: http://www.irp.wisc.edu/faqs/faq1.htm

    NOTE: The ACS does not determine income status for people living in institutional group quarters (such as prisons or nursing homes), college dormitories, military barracks, or in situations without conventional housing (such as shelters), or for unrelated individuals under age 15 (such as foster children). These individuals are excluded from the 'total' count in the denominator.

    Projected number of individuals in each income category in 2020 and 2030:
    Current population rate for income level, multiplied by the total population in state or county 2020/2030 as projected by Jones and Schwartz (2013), adjusted for ACS non-response.

    ACS non-response refers to the number of individuals for whom the ACS does not determine a certain outcome (here: income status for people living in institutional settings, see above) or who are not asked an ACS question, for example because the question is only asked of individuals over age 15 (see 'Disability' below). We adjust for ACS non-response by multiplying by the ratio of the current estimated number of individuals in each age category (here: income

levels), divided by the total number of individuals in that age category, as reported by ACS in 2009-2013 in table B01001. The minimum no-response adjustment was 93%.

4. **Age and Disability:** Cross-tabulation by age categories (5-17, 18-64 and 65+ years) and disability categories, defined above.

   Data source: Current Demographics tables C4 and C5 (ACS custom data)

   Current population rate calculated as:

   Numerator: Number of individuals in each disability and age category, representing the sum of individuals living alone (table C4) and living with 2 or more household members (table C5).
   Denominator: Total number of individuals in age category for whom disabilities were asked and income was determined (due to 2009-2013 ACS custom data availability).

   Projected number of individuals in each age and disability category in 2020 and 2030: Current population rate for age and disability category, multiplied by the total projected number of individuals in that age category in 2020/2030 by Jones and Schwartz (2013), adjusted for ACS non-response. The ACS non-response adjustment ranged from 95% to 98%.

   NOTE: ACS publishes data for the age groups 5-17 (because disabilities are not asked of individuals under 5 years of age), 18-64 and 65 years and older, while Jones and Schwartz (2013) has estimated population sizes in five-year increments. To adjust for this, we calculated the sum of individuals projected by Jones and Schwartz (2013) in age categories 5-9, 10-14 and 3/5ths of the 15-19 age category, to estimate the number of individuals in the 5-17 age bracket. To estimate the number of individuals in the 18-64 age category, we subtracted the number of individuals aged 65 and older, and individuals below 20 years, from the total projected population size in a county or the state in 2020/2030, to which we added 2/3rds of the estimated number of individuals in the 15-19 age group.

5. **Age and Income (FPL):** Cross-tabulation of age groups (0-17, 18-64, 65+, and 65-74, 75-84 and 85+) and income (below (<100% FPL) and at/above poverty level (≥100% FPL)).

   Data source: Current Demographics table B2 (ACS public data tables B17001 for age groups 18-64, 65+, 65-74; and B17020 for age groups 0-17, 75-84 and 85+)
   Where:
   0-17 years: Sum of <6 years, 6-11 years and 12-17 years
   65+ years: Sum of 65-74 years and 75 years and older, summed for males and females
   18-64 years: Sum of 18-24, 25-34, 35-44, 45-54, and 55-64 years, summed for males and females

   Current population rate calculated as:

   Numerator: Number of individuals in each age category and income level.
   Denominator: Total number of individuals in age category for whom income is determined

Projected number of individuals in each age and income category in 2020 and 2030: Current population rate (above) for age and disability category, multiplied by the total population in age group in 2020/2030 as projected by Jones and Schwartz (2013), adjusted for ACS non-response. The ACS non-response adjustment ranged from 87% to 99%.

6. **Age, Income (FPL) and Disability:** Cross-tabulation of age categories (5-17, 18-64 and 65+ years), income categories (<100% FPL, 100-200% FPL and >200% FPL), and disability categories defined above.

    Data source: Current Demographics tables C4 and C5 (ACS custom data)

    Current population rate calculated as:

    Numerator: Number of individuals at each disability, age and income category, representing the sum of individuals living alone (C4) and living with 2 or more household members (C5)
    Denominator: Total number of individuals in each age category for whom poverty was determined and disabilities were asked

    Projected number of individuals in each age and income category in 2020 and 2030: Current population rate for each age, disability and income category, multiplied by total population in age group in 2020/2030 as projected by Jones and Schwartz (2013), adjusted for ACS non-response. The ACS non-response adjustment ranged from 95% to 98%.

Estimating variability in future population size

The level of uncertainty associated with projecting future population demographics was estimated in two different ways:
1) Calculating high and low estimates for current population rates, and
2) Modeling projections under two different sets of assumptions pertaining to the overall economy and migration rates in Vermont in 2020 and 2030 (see note on Scenarios A and B at the beginning of this document).

Specifically:

1) High and low estimates

For each projected category of individuals, we present low, midpoint and high estimates. Our lower- and upper-bound population projections are based on the "Margin of Error" (MOE) that accompanies each estimate in ACS data tables.

The MOE offers Census data users a measure of data quality (Torrieri, 2007) and indicates whether the estimate is likely to reflect the true value in the entire population. For example, if the population estimate based on the partial survey sample is 100 and the MOE is +/- 20, then the true value for the entire population could be any value between 80 and 120. These high and low estimates are also called

lower and upper confidence bounds. They are calculated by adding or subtracting the MOE to/from the estimate.

All ACS estimates include MOEs at the 90% confidence level, meaning that we can be 90% certain that the true population value lies between the lower and upper confidence bounds. Sampling error results when a survey produces estimates of the whole population using information collected from a portion of the population (Torrieri, 2007).

We used published MOEs that accompanied ACS data tables (as calculated by the U.S. Census Bureau), or calculated MOEs ourselves in instances where two or more categories of individuals were summed to arrive at aggregates (e.g. males and females, to arrive at a total number of individuals) or divided to calculate rates. MOEs for aggregate numbers of individuals were calculated using the guidance for 'Calculating MOEs for Aggregated Count Data' by the U.S. Census Bureau. For further details, see '*A Compass for Understanding and Using American Community Survey Data: What General Data Users Need to Know'* published by the U.S. Census Bureau, pages A14-A16.

We calculated MOEs for aggregate numbers of individuals as the square root of the sum of the squared MOEs for individual categories:

$$MOE_{agg} = \pm\sqrt{\sum_{c} MOE_c^2}$$

Where

- MOE_{agg} represents the MOE for the aggregate (summed) measure, and
- MOE_c represents the MOEs for the individual categories (e.g. age groups or gender).

We then calculated MOEs for current population rates, also using guidance by the U.S. Census Bureau on 'Calculating MOEs for Derived Proportions'. The formula for this calculation is:

$$MOE_p = \frac{\pm\sqrt{MOE_{num}^2 - (\hat{p}^2 * MOE_{den}^2)}}{\hat{X}_{den}}$$

Where

- MOE_p represents the MOE for the derived proportion (percent) for the current population rate,
- MOE_{num} represents the MOE for the numerator,
- MOE_{den} represents the MOE for the denominator, and
- X_{den} represents the estimate for the total population (denominator).

In instances where this formula failed (that is, it produced negative numbers under a square root), the ACS User Guidance recommends 'Calculating MOEs for Derived Ratios' (p. A-15), instead. The shaded cells in this workbook use the Derived Ratio formula for calculation MOEs for Current population rates. The formula for this calculation is:

$$MOE_R = \frac{\pm\sqrt{MOE_{num}^2 - (\hat{R}^2 * MOE_{den}^2)}}{\hat{X}_{den}}$$

Where

- MOE_R represents the MOE for the derived ratio (proportion, or percent) for the current population rate,
- MOE_{num} represents the MOE for the numerator,
- MOE_{den} represents the MOE for the denominator, and
  X_{den} represents the estimate for the total population (denominator).

Example calculation: Estimated number of individuals aged 65 years or older with both cognitive and functional difficulties in the state of Vermont, in 2030, projected under scenario B assumptions (weaker economy, less migration).

Mid-point estimate: Calculated by multiplying the current proportion of individuals in each category from ACS 2009-2013 data (Current Demographics tables) by the projected number of individuals in each age and geographic area (Jones and Schwartz, 2013), adjusted for ACS non-response.

Current population rate, midpoint:

Estimated number of older adults aged 65 years and older, with cognitive and functional difficulties, in 2009-2013 (from Current Demographics table C4 and C5; custom ACS data): **5,960.**

Estimated total number of older adults aged 65 years and older in Vermont for whom the ACS determines disability and income level, in 2009-2013 (from Current Demographics table C4 and C4; ACS data): **90,970.**

Current population rate, mid-point: Estimated proportion of older adults aged 65 years and older in Vermont with both cognitive and functional difficulties, in 2009-2013: 5,960 / 90,970 = **6.55%**

Current population age 65 and older

Estimated total number of older adults aged 65 years and older in Vermont in 2030 (sum of five-year age categories 65-69, 70-74, 75-79, 80-84, 85 and older, from Jones and Schwartz, 2013): **166,996**.

Adjustment for ACS non-response:

Total population aged 65 years and older reported by ACS; 2009-2013 five-year estimates from table B01001 (male + female were summed, as were the age categories 65 and 66 years, 67 to 69 years, 70 to 74 years, 75 to 79 years, 80 to 84 years, and 85 years and over): **95,078**

Total population aged 65 years and older for whom ACS determines disability and income; 2009-2013 five-year estimates from custom ACS data: **90,970**

Adjustment for ACS non-response, ratio of ACS responders to the total population: 90,970 / 95,078 = **95.6793%**

Estimated population aged 65 and older, adjusted for ACS non-response adjustment: 166,996 * 95.6793% = **159,781**

Estimated number of adults aged 65 years and older with cognitive and functional difficulties in Vermont in 2030, Mid-point estimate: 6.55% * 159,781= **10,468**

Low estimate: We calculated MOEs for proportions using a method prescribed by the U.S. Census Bureau (see 'Estimating variability' above). Low estimates were calculated as the current population rate (%) – MOE for the derived proportion.

High estimate: High estimates were calculated as the current population rate (%) + MOE for the derived proportion.

MOE calculation for derived proportion of older adults with both cognitive and functional difficulties (6.55%):

$$MOE_{6.55\%} = \frac{\pm\sqrt{462^2-(0.0655^2*1328^2)}}{90{,}970} = 0.50\%$$

Current population rate, Low estimate: 6.55% - 0.50% = 6.05%

Current population rate, High estimate: 6.55% + 0.50% = 7.05%

Low estimate: 6.05% * 159,781= **9,671**

High estimate: 7.05% * 159,781= **11,265**

Assumption underlying these estimates: The proportion of older adults aged 65 years and older with both cognitive and functional difficulties remains constant between the baseline period (2009-2013) and the projected year (2030).

Estimating variability in the change in proportion of individuals in each category over time

As stated earlier, all projections presented in this databook assume that the proportion of individuals in each category remains constant between the baseline period (2009-2013) and the projected years (2020 and 2030). We did not have data available to calculate an MOE for the change in these proportions and there is no consensus in the literature as to the directionality (increase or decrease in rates) and magnitude of the projected change over time. We encourage users to apply an alternative methodology to calculate high and low estimates according to a method used by Smith and colleagues (2008). This method applies a 5% per-decade fall or rise in the percentage of individuals in a particular category (age, disability, income). Below we review how each estimate can be calculated:

Low estimate: Percentage of individuals per category in 2009-2013, reduced by 5% for 2020, and 10% for 2030 projections.

High estimate: Percentage of individuals per category in 2009-2013, increased by 5% for 2020, and 10% for 2030 projections.

For example, for a particular value, if the excel workbook shows a low estimate of 10,000 individuals in a group, a user could further apply a 5% per-decade fall in the percentage of

individuals in that particular category by multiplying this low estimate by 0.95 for 2020 (-5%; 9500 individuals) and 0.90 for 2030 (-10%; 9000 individuals).

Similarly, if the excel workbook shows a high estimate of 20,000 individuals in a group, a user could further apply a 5% per-decade rise in the percentage of individuals in that particular category by multiplying by 1.05 for 2020 (+5%; 21,000 individuals) and 1.10 for 2030 (+10%; 22,000 individuals).

References and further reading

Jones K, Schwartz L (2013) Vermont Population Projections – 2010 - 2030. Vermont Agency of Commerce and Community Development, August 2013. Available at: http://dail.vermont.gov/dail-publications/publications-general-reports/vt-population-projections-2010-2030 [Accessed 12-8-16]

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