

Utah Population Committee Methodology

The Utah Population Committee (UPC) produces a set of annual state and county population estimates for Utah and its counties. This work has included the replication of established methods and exploration of potential innovations for both data and techniques. This paper documents this work.

The Population Division of the U.S. Census Bureau produces similar annual estimates for all states and counties using nationally available data sets and uniform methods. The advantage of their work is that comparisons may be made between estimates for counties and states nationally. However, these methods do not incorporate a contextual understanding of local events, conditions, and data. Consequently, most states, including Utah, support independent research programs to track local changes and to produce their own set of estimates.

The initial approach of UPC was to maintain theoretical and technical continuity with that of its predecessor, the Utah Population Estimates Committee (UPEC), which has a long and rich history in Utah of developing and producing state and county level population estimates¹. An initial set of estimates did not adequately capture the effects of the missionary age change within The Church of Jesus Christ of Latter-day Saints (LDS Church) and the subsequent unusual migration patterns². Recommendations resulting from the December 2015 review resulted in further data development and methodological refinements intended to capture these unique migration patterns.

Estimation Methods

UPC averages the results of four methods to produce population estimates for each county. The state total population estimate is the sum of these county totals. The methods include the LDS Membership Method, the IRS Exemption Method, Housing Unit Method, and School Enrollment Method. These are each detailed below. The estimates are produced for July 1 of each year. Flow variables include births, deaths, natural increase, and net migration and are measured for July 1 fiscal year periods.

Three (LDS, IRS, and Housing Unit) of the four estimation methods use the standard residual method of population estimation. County population estimates for July 1 are derived by computing fiscal year changes in symptomatic data and applying these to the previous year population. Fiscal year natural increase (births minus deaths) is subtracted from the updated population estimate to derive net migration as the residual.

$$NM = (P_t - P_{t-1}) - (Births - Deaths)$$

where

- NM = Net Migration (for the fiscal year from t-1 to t)
- P = Population (stock variable at a point in time)
- B = Births (total for the fiscal year from t-1 to t)
- D = Deaths (total for the fiscal year from t-1 to t)
- t = Time

The School Enrollment Method uses the cohort approach in three steps using the following equations:

1. **Implied student migration**_(t-1 to t) =

$$[(\text{School Enrollment Grades } 2 - 9_t) - (\text{School Enrollment Grades } 1 - 8_{t-1})] * .9998$$

2. **Net Migration**_(t-1 to t) = $\frac{P_{t-1}}{(\text{School Enrollment Grades } 1-8_{t-1})} \times \text{Implied student migration}_{(t-1 to t)}$

3. $P_t = P_{t-1} + (\text{Births} - \text{Deaths}) + \text{Net migration}_{t-1 to t}$

where P = Population (stock variable at a point in time)
 B = Births (total for the fiscal year from t-1 to t)
 D = Deaths (total for the fiscal year from t-1 to t)
 t = Time

This method estimates Net Migration, instead of the current population estimate, and uses the above formula (equation 3) to calculate the population estimate.

Natural Increase

Natural increase is calculated by subtracting the number of deaths from the number of births for the July 1 fiscal year. The Utah Department of Health provides the updated residence adjusted vital records by county to the DUPC.

School Enrollment Method

The School Enrollment Method uses aged and survived changes in school enrollment as an indicator of net migration. This method compares a county's survived enrollment (calculated by applying a survival rate of 99.98% to the enrollment count) in grades 1 to 8 for the year prior to the estimate year, to enrollment in grades 2 to 9 for the estimate year. The difference between these two enrollment totals is taken to be net student migration for the county. Total net migration from the school enrollment method for the county is then derived by multiplying the county's student migration estimate by the county specific total population to student ratio. This ratio is defined as the total population estimate of the county for the prior year divided by the same year's enrollment in grades 1 to 8.

UPC incorporates updated annual enrollment counts from each county provided by the Utah State Office of Education (USOE). Their selection criterion consists of: state residency, enrolled in public local education or charter schools, enrolled on October 1st, at least one day of enrollment in regular or special education programs, enrolled in a grade level from Kindergarten to 12th grade, students attending the state sponsored deaf and blind schools, and foreign exchange students.

LDS Membership Method

This method applies the annual growth rate in LDS Church membership in a particular county to the previous year's population estimate for the county. The growth in LDS membership, then, is an indicator of population growth. The LDS membership data is extracted annually on September 30 in order to capture a more accurate representation of the usual population of counties in Utah, especially those counties with large university populations. This membership data is provided to UPC by their representative on the committee.

The traditional LDS method (developed by UPEC) calculates the annual percentage growth rate of LDS membership from the previous year and applies that growth rate to the previous population estimate to compute the population estimate for the subsequent year. This method is accurate given historically stable resident membership and missionary populations as a shares of the total population. However, the changes in missionary migrations in 2013 through 2015 significantly altered these annual shares.

UPC incorporates a missionary adjustment to account for the annual increments in active missionaries by county by using the same membership dataset with active missionaries excluded. These differences are subtracted from the initial population estimate produced by the LDS method which creates an adjusted LDS method population estimate series. This method change is particularly useful for the years 2013 through 2015 as a means to track the unusual increases and decreases in active missionaries by county. The data enables us to explain and interpret these effects, particularly migration, on the resident population.

IRS Method

The Utah State Tax Commission provides UPC with data containing the annual counts of the number of tax returns and exemptions filed by county. This method uses the growth in exemptions as reported on tax returns filed with the IRS as an indicator of population change. The current population estimate uses a growth rate from the sum of exemptions from two years prior, and the sum of exemptions from the year prior to the current year (i.e., 2010 IRS method uses 2008 and 2009 calendar year exemptions to generate growth rate). The growth rate in exemptions is then applied to the previous fiscal year population to estimate the current fiscal year population.

An important point to note: previous UPEC methods used different forms of IRS exemptions in 2010 and 2011 due to certain tax-filing patterns for those years, and then used the non-restricted exemptions from 2012-2014, so we followed suit. The IRS 2010 estimates used the 2008 and 2009 total exemptions from returns with Federal Adjusted Gross Income (FAGI) exceeding \$10,000. The 2011 IRS method was based on total exemptions from all 2009 and 2010 returns with positive FAGI. The 2012 estimates and on used the full, non-restricted exemptions.

Modified Housing Unit Method

As with LDS membership and IRS tax exemptions, housing growth is used for an indicator of population growth. Updated housing unit data is acquired from the Ivory-Boyer construction database at the University of Utah³. The method starts with the housing stock that is estimated for July 1, using the previous calendar year's approved permit data multiplied by a factor of 1.0389⁴, previously used in UPEC's estimation methods. The growth rate in the housing stock is applied to the previous year's July 1 estimate to develop the current year July 1 estimate.

Identifying Outliers

The committee uses what is known as the Q-statistic Outlier Detection Method or Dixon's Q. Most simply, Q is the ratio of the range of methods with the outlier excluded to the initial range based on all methods. While Q can be applied as a hypothesis test assuming a probability distribution, UPEC has previously used it less rigidly as a means to reduce the range of the methods in a given county. The test is useful because rejection values change depending on the number of observations, taking into account the increased amount of expected variability in a lower number of observations.

Given that we currently use four observations, we adopted a rejection value of .964 to correspond to a level of significance of .001. This updated rejection value reflects the different number of observations in UPC's estimates while still maintaining the same significance level as previous UPEC estimates.

A Note on the 2010 Estimates:

In order to produce July 1st 2010 estimates from the April 1st, 2010 Census data, certain adjustments were made to estimate the amount of growth in a quarter of the year:

Natural Increase was estimated using the monthly birth and death records from April 1st through June 30th, 2010.

In the School Enrollment Method, we used a quarter of the amount of the implied student migration numbers to adjust the estimated net migration.

In both the IRS and LDS Method, the growth rate was derived from only a quarter of the absolute difference between the previous and current year's numbers.

The Housing Unit Method used the calculated Census April 1, 2010 Housing Stock numbers and updated the housing stock with building permit information from October 1, 2009 to December 31, 2009.

¹ Please reference the following link for an in-depth write-up of the UPEC Estimation Methodology:

<http://governor.utah.gov/DEA/Publications/04Estimates/2009MethodsDocumentation.pdf>

² The Church of Jesus Christ of Latter-day Saints (2012) Missionary Age Changes. Retrieved from

<https://www.lds.org/youth/video/welcome-to-conference?lang=eng>

³ Ivory Boyer Construction Report and Database. Accessed from <http://gardner.utah.edu/ivory-boyer-construction-database/>

⁴ Utah Population Estimates Committee. (2010). 2009 Population Estimates: Methods Documentation. Retrieved from <http://governor.utah.gov/DEA/Publications/04Estimates/2009MethodsDocumentation.pdf>.