Life Table Methodology

The life expectancy estimates for this project were calculated by constructing abridged period life tables for each census tract for the period 2010-2015. Abridged period life tables translate the mortality observed in a specific period for a particular population into measures such as the probability of dying and the average number of years of life remaining. Life expectancy at birth is the average number of years that an actual group of infants would live if they were to experience throughout their entire lives the mortality observed in a specific period and place, such as a census tract. Abridged period life tables were constructed using death certificate data from state vital statistics offices and population estimates from both the 2010 U.S. decennial census and the 2011-2015 American Community Survey (ACS) 5-year survey.

There are two types of life tables, cohort and period life tables. A cohort life table presents the mortality experience of a real birth cohort from birth through consecutive years until all members of that cohort have died. To construct a cohort life table requires many years of mortality data about a real cohort of persons until all members have died. For example, it would not be feasible to construct a life table for a cohort of persons born in 1965 because most have not died yet. A period life table instead presents the mortality experience of a population during a particular point (period) in time. Age-specific death rates of an actual population in a particular period and place are applied to a hypothetical birth cohort; usually 100,000. Under the assumption that the hypothetical cohort will experience at every age until all members have died the mortality of a real population in a particular place and period, the period life table provides detailed mortality information, such as the probability of dying and life expectancy by age for the population from which the death rates were gathered.

In addition, life tables are classified by the size of the age intervals. A complete life table includes information for every single year of age except the final age group, which is usually open-ended. An abridged life table aggregates ages into 5 or 10-year intervals, with the exception of the first (0-1) and second (1-4) age categories and the final open-ended age interval. The selection of either a complete or abridged life table is dependent on the availability of age-specific mortality and population data. For small geographic areas, an abridged life table is preferred since it is very likely that single-year of age mortality and population data are not available to construct death rates.

Life tables, whether complete or abridged, include seven columns:

- *Age* – The age interval between two exact ages, *x and x+n*. The type of life tables constructed for the USALEEP project are abridged period life tables with 10-year age intervals.

- *Probability of dying*, $_nq_x$ – The probability of dying between two exact ages, *x and x+n.*

- *Number surviving*, l_x – The number of persons surviving to the beginning of the age interval from the original 100,000 hypothetical live births.

- *Person-years lived*, $_nL_x$ – The number of person-years lived by the hypothetical life table cohort within an age interval *x and x+n.* Person-years lived refers to the number of years lived by the total number of individuals in the age interval.

- *Total number of person-years lived*, T_x – The number of person-years that would be lived after the beginning of the age interval *x and x+n.*

- *Expectation of life*, e_x -- The average number of years to be lived by those surviving to age *x.*

The first step in the calculation of a period life table is the estimation of the age-specific death rate (ASDR) for the population and period of interest. The ASDR is the number of age-specific deaths in the period divided by the mid-period population. The probability of dying, $_nq_x$, the first life table function, is estimated from the ASDR. All other life table functions are derived from $_nq_x$. Usually, a period life table starts with a hypothetical population of 100,000.

The life table functions provide a dynamic portrait of the death and survival processes of a population. Among statistical methods, the period life table stands alone with respect to the amount of information about what can be learned about a population. One single life table provides an in-depth picture of the mortality and survival experience of a population. It includes information about the probability of dying at every age, the number dying out of the original cohort, the number surviving to each age, the amount of time contributed to each age, the total amount of time contributed to subsequent ages for those who survive to the specific age, and, finally, the average number of years cohort members can expect to live after surviving to a particular age. No other statistical measure provides this amount of information about the mortality profile of a population.

Period life tables can be used to describe the mortality profile of particular populations and to compare the mortality experience of different populations. For example, much can be learned about the economic, social, and demographic characteristics of populations through comparisons of their life table functions. For instance, life expectancy and the probability of dying at birth provide information about infant mortality, which is tightly linked to social and economic development. Similarly, life expectancy and the percent surviving to the oldest ages, for example ages 85 and older, reveal a great deal of information about the age structure and aging of a population. These are just a few examples of how the life table functions can be used to describe and compare different populations and identify the underlying socioeconomic and demographic structures associated with mortality outcomes.