Demography

Guide to the methods used by ONS to produce national life expectancies.

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1 . Guide to calculating national life tables

Introduction

National life tables, which are produced annually for the UK and its constituent countries, provide period expectation of life. This is the average number of additional years a person can be expected to live for if he or she experiences the age-specific mortality rates of the given area and time period for the rest of his or her life.

Each life table is based on the population estimates and deaths by date of registration data for a period of 3 consecutive years. This helps to reduce the effect of annual fluctuations in the number of deaths caused by seasonal events such as winter 'flu. The national life tables are based on the mid-year population estimates and corresponding data on births, infant deaths and deaths by individual age from those years (the calculation of infant mortality also requires monthly births data for the year before the 3-year period – Appendix A).

Summary quality reports for the data used in the calculation of national life tables are available here: births (257.9 Kb Pdf), deaths (222.3 Kb Pdf) and population estimates (236.8 Kb Pdf).

Life tables

Life tables are usually constructed separately for males and females because of their very different mortality patterns. A life table describes the course of mortality throughout the life cycle. A life table contains:

mx

The central rate of mortality, defined as the average annual number of deaths at age x last birthday in the 3-year period to which the national life table relates, divided by the average population at that age over the same period.

qx

The mortality rate between age x and (x +1); that is, the probability that a person aged x exactly will die before reaching age (x +1).

lx

The number of survivors to exact age x of 100,000 live births of the same sex who are assumed to be subject throughout their lives to the mortality rates experienced in the 3-year period to which the national life table relates.

dx

The number dying between exact age x and (x +1) described similarly to lx, that is, $d_x = l_x - l_{x+1}$.

ex

The average period expectation of life at exactly age x, that is, the average number of years that those aged x exactly will live thereafter based on the mortality rates experienced in the 3-year period to which the national life table relates.

Methodology

Starting with a radix of 100,000 simultaneous births (l_0), the life table population is calculated by multiplying l_0 by q_0 to give d_0, the number of deaths aged 0. The resulting d_0 is then subtracted from the l_0 to give l_1. Similarly l_2 is l_1 less d_1 (where $d_1 = l_1 \times q_1$) and so on.

Generally:

$$d_x = q_x - l_x \quad l_{x+1} = l_x - d_x$$

The calculation of expectation of life at each age

In order to calculate the expectation of life at exact age x, the number of "years alive" at each individual age (L_x) needs to be calculated.

For ages above 1, where deaths can be assumed to occur linearly over a year of age, this can be taken as:

The calculation of expectation of life at each age

$$L_x = \frac{l_x + l_{x+1}}{2}$$

Below age 1, this assumption is unrealistic. L0 is calculated using the following formula: $L_0 = a_0 \cdot l_0 + (1 - a_0) l_1$

where a_0 is the average age of death of those dying within the first year of life (see Appendix A). Summing the L_x column from age x to the oldest age gives the total number of years lived (T_x) from age x. The period expectation of life at exact age x is given by dividing the number of years lived by the number at that age, that is:

Calculation

$$\frac{T_x}{l_x}$$

For more information on life tables and their calculation, see: Shyrock, H S (1971) The Methods and Materials of Demography, volume 1. US Bureau of the Census; or Hinde, A (1998) Demographic Methods. Arnold.

2 . Guide to period and cohort life expectancy

Expectations of life can be calculated in 2 ways: "period life expectancy" or "cohort life expectancy".

Period life expectancy at a given age for an area is the average number of years a person would live, if he or she experienced the particular area's age-specific mortality rates for that time period throughout his or her life. It makes no allowance for any later actual or projected changes in mortality. In practice, death rates of the area are likely to change in the future, so period life expectancy does not therefore give the number of years someone could actually expect to live. Also, people may live in other areas for at least some part of their lives.

Cohort life expectancies are calculated using age-specific mortality rates that allow for known or projected changes in mortality in later years and are thus regarded as a more appropriate measure of how long a person of a given age would be expected to live, on average, than period life expectancy.

For example, period life expectancy at age 65 in 2000 would be worked out using the mortality rate for age 65 in 2000, for age 66 in 2000, for age 67 in 2000, and so on. Cohort life expectancy at age 65 in 2000 would be worked out using the mortality rate for age 65 in 2000, for age 66 in 2001, for age 67 in 2002, and so on.

Period life expectancies are a useful measure of mortality rates actually experienced over a given period and, for past years, provide an objective means of comparison of the trends in mortality over time, between areas of a country and with other countries. Official life tables in the UK and in other countries which relate to past years are generally period life tables for these reasons. Cohort life expectancies, even for past years, usually require projected mortality rates for their calculation and hence, in such cases, involve an element of subjectivity.

Period life expectancies are sometimes mistakenly interpreted by users as allowing for subsequent mortality changes. Period life expectancy answers the question "For a group of people aged x in a given year, how long would they live, on average, if they experienced the age-specific mortality rates above age x of the period in question over the course of their remaining lives?"

The cohort life expectancy answers the question "For a group of people aged x in a given year, how long would we expect them to live, on average, if they experienced the actual or projected future age-specific mortality rates not from the given year but from the series of future years in which they will actually reach each succeeding age if they survive?" If mortality rates at age x and above are projected to decrease in future years, the cohort life expectancy at age x will be greater than the period life expectancy at age x.

3 . English Life Tables, No. 17, 2010-2012 Methodology

New methodology explaining the graduation method.