

COMMENTARY ON PAPER BY CHRISTENSEN ET AL.

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In February 2009, a group of researchers from Denmark and Germany published a very interesting review of the challenges facing ageing populations. They begin the article by presenting some projections of the likely ages to which birth cohorts (babies born in a particular year)

Their Table 1 is reproduced below. In the text of the article they say:

“Most babies born since 2000 in countries with long-lived residents will celebrate their 100th birthdays if the present yearly growth in life expectancy continues through the 21st century (table 1). This forecast is based on the assumption that mortality before age 50 years will remain at 2006 levels. At age 50 years and older, probability of dying decreases by a rate that yields yearly improvements in period life expectancy of 0.2 years. More complex methods can be developed on the basis of the assumption that life expectancies will increase linearly; however, such models produce similar estimates to those given in table 1.”(Christensen et al. 2009, p.1196).

Table 1: Oldest age at which at least 50% of a birth cohort is still alive in eight countries

Country	2000	2001	2002	2003	2004	2005	2006	2007
Canada	102	102	103	103	103	104	104	104
Denmark	99	99	100	100	101	101	101	101
France	102	102	103	103	103	104	104	104
Germany	99	100	100	100	101	101	101	102
Italy	102	102	102	103	103	103	104	104
Japan	104	105	105	105	106	106	106	107
UK	100	101	101	101	101	102	103	103
USA	101	102	102	103	103	103	104	104

Source: Christensen et al. (2009), p.1197.

The authors assume that the reader knows how to compute a cohort life table and how to project the mortality rates that are used in that life table. In the training exercise we will try to replicate the work that underpins the results of Table 1, for babies born in Scotland in 2006.

To understand the table and the method we need to ask and then answer a series of questions:

How do the ages quoted in Table 1 relate to a life table?

You compute in a life table the number of survivors of a hypothetical cohort, the variable l_x . The start value, l_0 , is conventionally set to 100,000, representing babies born during a year. As you increase age x the numbers in this cohort decrease, slowly at first but then faster after age 60. The percentage of the population alive at each age is $100 \times (l_x/l_0)$. This figure starts at 100 at age 0 and declines to 0 at age 115. You then look through the values for the ages until you find the smallest value that is still above 50%. The age at which this occurs is “the oldest age at which at least 50% of the birth cohort is still alive”. Table 2 illustrates the concept with some made up numbers.

Table 2: An illustrative extract from a life table showing how the ages in table 1 were derived

Age	l_x	% still alive
0	100,000	100.00
1	98,980	98.98
:	:	:
95	50,340	50.34
96	49,250	49.25

In this case the age is 95. You can also work out the exact age at which 50% are alive by linear interpolation (called the median life expectancy) as:

$$\text{Median life expectancy} = [(50,340-50,000)/(50,340-49,250) \times 1] + 95 = 95.3119.$$

How are mortality rates projected into the future?

Christensen et al. (2009) refer to assumptions about mortality rates at particular ages e.g. below 50 rates are assumed to remain constant. They don't spell out how mortality rates above 50 are projected. One way, which we will use, is to measure the percentage decline in mortality rates, m_x , between one year and the next and apply that percentage decline into the future. Christensen et al. use a model in which probabilities of dying, q_x , are decreased into the future. They translate the declines in probabilities of dying into statements about the increase in life expectancies of 0.2 of a year per year. Life expectancies are used in this case as a reporting variable rather than a leading indicator.

Will mortality rate declines observed in the recent past continue into the future?

There is a good deal of debate about this. Oeppen and Vaupel (2002) say yes they will. Others, such as Olshansky et al. (2005) say that the rate of decline will slow down because of the obesity epidemic. National Statistics in the National Population Projections (ONS 2008) take an intermediate view that declines will slow down to only 1% (compared with 2.5% in 1975-2000) but continue thereafter.

References:

Christensen, K., Doblhammer, G., Rau, R. and Vaupel, J. (2009) Ageing populations: the challenges ahead. *Lancet* 374: 1196-1208.

Oeppen, J. and Vaupel, J.W. (2002) Broken limits to life expectancy. *Science* 296: 1029-1031.

Olshansky, S.J. et al. (2005) A potential decline in life expectancy in the United States in the 21st century. *The New England Journal of Medicine*, 352(11): 1138-1145.

ONS (2008) *National Population Projections, 2006-based*. Series PP2, No 26. Basingstoke: Palgrave-Macmillan.