Patterns of Mortality Decline and Individual Ageing: An Overview

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While individuals who succeed to survive to extreme ages were rare a few decades ago, the chances to live beyond age 100 have dramatically increased in many developed countries. The proliferation of such very old individuals is a consequence of the remarkable improvement in mortality for octogenarians and nonagenarians that was achieved over the last decades throughout the developed world. However the underlying mechanisms of these mortality improvements are not fully understood. In humans, adult and early-old mortality increases exponentially up to about age 80 and thereafter decelerates due to the impact of selective survival in heterogeneous populations (Vaupel et al., 1979; Barbi et al. 2003) – see Figure 1. A recent study on supercentenarians, that is people who reached ages of 110 or more, suggests that mortality is constant after age 110 (Maier et al., 2010). This result also fits with the theory of the selective survival. An explanation for the observed mortality trajectory, and its changes over time, has been recently given by Vaupel (2010). According to his hypothesis, all individuals would be heterogeneous in their level of mortality but not in their relative increase of the force of mortality with age, the so called rate-of-ageing, that would stay constant over time and across populations Thus, the observed convergence at the highest ages of the mortality trajectories at population level over time (see Figure 1) would be a mere consequence of the selective process in heterogeneous populations. Mortality improvements would then been achieved by lowering individual mortality but not by decelerating or accelerating the individual ageing process.

To shed light on human ageing and the mechanisms of mortality improvements, information on the behaviour of the force of mortality at extremes is essential. The asymptotic properties of mortality models have been recently studied by Finkelstein and Esaulova (2006) and by Missov and Finkelstein (2011). These findings help to derive age-trajectories of mortality for individuals from age-trajectories for populations. To estimate the exact mortality trajectory for individuals and their rate of ageing, several complex parametric and non-parametric models incorporating mortality

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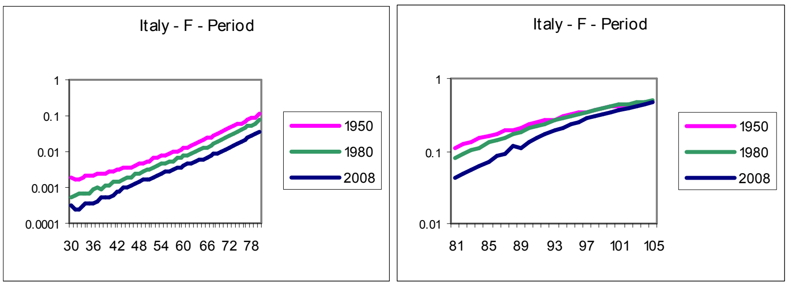
selection and mathematically implying a mortality plateau at the extreme ages have been devised, without however bringing to conclusive results. This study provides an overview of the recently proposed solutions and their findings, and gives directions for fine-tuning the methodology and for further research.

Figure 1. Probability of dying (log-scale) for Italian women, in 1950, 1980, 2008, ages 30-105.



Source: Data from HMD (www.mortality.org)

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