Estimating the Rate of Aging on Human Mortality Surfaces

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Keywords: frailty model, Poisson likelihood, rate of aging, mortality surface

The individual rate of aging is defined as the relative derivative of one's risk of death with respect to one's age. The *b*-hypothesis, formulated by Vaupel (see [1]), postulates that all humans share the same rate of aging. In order to check this hypothesis given the existing aggregate data on human mortality, we present several statistical approaches, their advantages and shortcomings, as well as some preliminary conclusions.

Lifetable adult mortality data (death counts and exposures in the absence of explanatory variables) are usually fit parametrically by a gamma-frailty model with a Gompertz-Makeham baseline (see [2]). Its straight application to cohort mortality data produces, though, dubious parameter estimates as it does not incorporate improvements in age-specific mortality rates that occur yearly. One possibility of dealing with this is to design an estimation procedure on mortality surfaces for a fixed age range over a fixed period of time:

$$\bar{\mu}(x,y) = \bar{z}(x_0, y-x) \cdot \bar{S}^{\gamma} \cdot a(x_0,y) \cdot e^{b(x-x_0)} \,,$$

where $\bar{\mu}(x,y)$ demotes marginal hazard; $\bar{z}(x_0, y-x)$ is the average frailty among survivors to age x_0 from the cohort born in year $y-x$; S is the $(y-x)$-cohort survivorship between ages x_0 and x; γ is the squared coefficient of variation of the frailty distribution; $a(x_0,y)$ and b are the Gompertz parameters. This model can be estimated in a number of special cases.

References

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