Alternatives to the Poisson distribution for modeling mortality projections

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ABSTRACT

The Poisson distribution is the most commonly used distribution in the context of mortality modeling. This is however a choice of convenience and tradition, which often cannot be justified empirically. The inadequacy of the Poisson distribution is rooted in the restricting equality of its mean and variance.

Alternative candidate distributions can be generated within the Natural Exponential Family whose variance functions allow non-linear dependence between the variance V(m) and the mean m of the underlying distributions. This way, for instance, the strict arcsine, the Abel-type and the Takács-type distributions are generated and characterized by the respective variance functions:

$$V(m) = m\left(1 + \frac{m^2}{p^2}\right),\ m \in \mathbb{R}^+,\ p > 0,$$

$$V(m) = m\left(1 + \frac{m}{p}\right)^2,\ m \in \mathbb{R}^+,\ p > 0$$

$$V(m) = m\left(1 + \frac{m}{p}\right)\left(1 + \frac{a+1}{a}\frac{m}{p}\right),\ m \in \mathbb{R}^+, a > 0,\ p > 0.$$

The study will focus on these and other distributions. Particular attention will be given to:

- The generation of these distributions and other alternative distributions whose variance functions belonging to the class

$$V(m) = m + m^k,\ k \in \mathbb{N},$$

(known also as the Hinde-Demétrio class)

- The incorporation of these distributions into mortality models
- The Modeling of covariates via generalized linear models
- Estimation issues