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**Appendix**

**Methodological Details**

1. Maximum Likelihood Estimation

For the estimation of the age-specific mortality rate (), we utilized the maximum likelihood estimation to select the best fitted parameters for the given mortality information. The likelihood equation has been developed by Missov et al. (2015), which writes:

The represents a vector of model parameters of our interest. The notation , and notation represents the number of deaths at each age, and population exposure at each age, respectively. The procedure was carried out in *R* with the package *DEoptim*.

1. Discrete Approximation of the Derivatives

The approximation procedures are adopted from the paper Vaupel & Canudas-Romo (2003) with the assumption that the changes in demographic function is a constant growth. The derivative equation is shown as:

with the mid-point function () )writes: