

Leveraging deep neural networks to estimate age specific mortality from life expectancy at birth

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Abstract

Life expectancy is one of the most informative indicators of population health and development. Its stability, which has been observed over time, has made the prediction and forecasting of life expectancy an appealing area of study. However, predicted or estimated values of life expectancy do not tell us about age-specific mortality. Reliable estimates of age-specific mortality are essential in the study of health inequalities, well-being and to calculate other demographic indicators. However, this task comes with several difficulties, including a lack of reliable data in many populations. Models that relate levels of life expectancy to a full age-specific mortality profile are therefore important but scarce. We propose a deep neural networks (DNN) model to derive age-specific mortality from observed or predicted life expectancy by leveraging deep learning algorithms akin to demography's indirect estimation techniques. Out-of-sample validation was used to validate the model, and the predictive performance of the DNN model was compared with two state-of-the-art models designed to do the same thing. Out-of-sample validation indicates that the DNN model provides reliable estimates of age-specific mortality for the USA, Italy, Japan and Russia using data from the Human Mortality Database. Furthermore, we show how the DNN model could be used to estimate age-specific mortality for countries without age-specific data using neighbouring information or populations with similar mortality dynamics.

Keywords: Life expectancy, Forecasting, Death rates, Deep Neural Network.