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Neural Networking Beyond Lee–Carter

A Song of Mortality Forecasting and Deep Learning

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Abstract

In recent years, numerous research papers have explored the application of deep learning in the field of actuarial science. This thesis aims to provide an overview of one such application: the use of deep learning models for mortality forecasting. Starting from the Lee–Carter model, we explore how neural networks can be employed to extrapolate the time index κ_t. We describe parameter estimation in the Lee–Carter model and outline traditional forecasting methods, where κ_t is typically modelled using an autoregressive integrated moving average (ARIMA) model—typically a random walk with drift. We then present an overview of artificial neural networks, with a focus on recurrent neural networks and their most widely used variant, the long short-term memory network (LSTM). These methods are applied to Swedish mortality data. We compare feedforward neural networks, shallow LSTMs, and deep LSTMs to traditional ARIMA-based forecasting. Ensemble models are used to reduce the randomness inherent in neural network training. Our results show that, for the given dataset, neural networks generally outperform traditional methods.

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