



## Statistics and Actuarial Science Seminar

**Title:** New machine learning techniques for long-term mortality forecasting

**Speaker:** Vékás Péter (Corvinus University of Budapest)

**Date:** Thu 21st September 2023 at 3:00PM

**Location:** E0.32 (beside Pi restaurant)

**Abstract:** Empirical studies show that rates of mortality decline vary greatly by age, gender, country and calendar year. In particular, the acceleration of mortality decreases among the elderly and a simultaneous slowdown of improvement at younger ages – jointly referred to as the rotation of the age pattern of mortality decline – have been observed in several populations. Since the world was hit by COVID-19, the picture has changed significantly, as the elderly have been more susceptible to die due to complications of the disease, which tends to moderate the impact of rotation. Vékás (2020) suggests a simple data-driven methodology for the empirical examination of this phenomenon, using which we present new results based on mortality data from the Human Mortality Database for several countries of the world, and demonstrate that previous long-term trends of rotation have been radically changed –, and in many cases, completely wiped out– by the pandemic. We explain why capturing changes in age patterns of mortality decline is crucial in long-term mortality forecasts in order to paint an accurate picture of longevity risk. The popular Lee–Carter model does not contain rotation, while Li, Lee and Gerland modify the original method to allow for it. We use age-specific mortality rates of all countries by gender from the Human Mortality Database, and optimize the hyperparameters of the Li, Lee and Gerland variant in order to improve its long-term forecasting performance. Additionally, we

introduce deep neural networks designed to capture the rotation of mortality decline in order to produce even more data-driven rotation schedules, and also propose a generalized additive model of the residuals of the Lee–Carter model. We select the most accurate method for every country, and present compelling evidence that improved machine learning techniques can significantly outperform traditional methods in terms of forecasting accuracy.