Fall Colloquium Series

Gaussian Process Models for Mortality Rates and Improvement Factors

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Abstract:

We develop a Gaussian process ("GP") framework for modeling mortality rates and mortality improvement factors. GP regression is a nonparametric, data-driven approach for determining the spatial dependence in mortality rates and jointly smoothing raw rates across dimensions, such as calendar year and age. The GP model quantifies uncertainty associated with smoothed historical experience and generates full stochastic trajectories for out-of-sample forecasts. Our framework is well suited for updating projections when newly available data arrives, and for dealing with "edge" issues where credibility is lower. We present a detailed analysis of Gaussian process model performance for US mortality experience based on the CDC datasets. We investigate the interaction between mean and residual modeling, Bayesian and non-Bayesian GP methodologies, accuracy of in-sample and out-of-sample forecasting, and stability of model parameters. We also document the general decline, along with strong age-dependency, in mortality improvement factors over the past few years, contrasting our findings with the Society of Actuaries ("SOA") MP-2014 and -2015 models that do not fully reflect these recent trends.

Key Words: Statistical modelling, Gaussian process, mortality rates

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