

# It's All in the Hidden States: A Hedging Method with an Explicit Measure of Population Basis Risk

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## Abstract

In this paper, we propose the generalized state-space hedging method for use when the populations associated with the hedging instruments and the liability being hedged are different. In this method, the hedging strategy is derived by first reformulating the assumed multi-population stochastic mortality model in a state-space representation, and then considering the sensitivities of the hedge portfolio and the liability being hedged to all relevant hidden states. Inter alia, this method allows us to decompose the underlying longevity risk into a component arising solely from the hidden states that are shared by all populations and components stemming exclusively from the hidden states that are population-specific. The latter components collectively represent an explicit measure of the population basis risk involved. Through this measure, we can infer that a portion of population basis risk depends on how the longevity hedge is constructed while another portion exists no matter what the notional amounts of the hedging instruments are. We present the proposed hedging method in both static and dynamic settings.

*Key words:* Coherent mortality forecasting; Index-based longevity hedges; Multi-population mortality models; State-space models

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