Safety margins for unsystematic biometric risk in life and health insurance

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In multistate life and health insurances, the pattern of states of the policyholder is random, thus exposing the insurer to an unsystematic biometric risk. For this reason safety margins are added on premiums and reserves. But in contrast to non-life insurance, traditionally the safety margins are not chosen explicitly but implicitly in form of a valuation basis of first order. If we define the implicit margins bottom-up, we are not able to control the level of safety that we finally reach for premiums and reserves. If we use a top-down approach, that means that we directly calculate explicit margins for premiums and reserves and then choose implicit safety margins that correspond to the explicit margins, we are able to control the total portfolio risk, but we have the problem that it is unclear how to allocate the total margin to partial margins for different transitions at different ages.

Although the allocation of the total margin to the partial (implicit) margins is not relevant for the total portfolio risk, we have to pay attention since it can have a great effect on the calculation of surplus.

We calculate asymptotic probability distributions for premiums and reserves of second order by using the functional delta method. As a result, we can not only determine the actual level of safety that is induced by given implicit safety margins, but we can also linearly decompose the total randomness of a portfolio to contributions that the different transition rates at different ages make to the total uncertainty. As a result we do not only get new insight into the sources of unsystematic biometric risk, but we also obtain a useful tool that allows to construct reasonable principles for the allocation of the total safety margin to implicit margins with respect to transitions and ages.