Kudryavtsev O. E. (InWise Systems, LLC, Rostov branch of the Russian Customs Academy, Rostov-on-Don, Russia). **Risk measures for variable annuities under Lévy processes**[1]**.**

Motivated by the effeciency of the frame projection method, developed for pricing Asian options with a fixed strike price and discrete price monitoring, we decided to extend this approach to the computing risk measures of variable annuities in exponential Lévy models. In the proposed approach, the probability density of net liabilities, expressed in terms of the final position and integral of the exponential Lévy process F'_t, is approximated using frame theory and Riesz bases using 3rd order B-splines.

Replacing the integral with a certain discrete sum correspondent to the partition of $[0,T]$ with the points $t_j = j\Delta t = j\frac{T}{M}$, and the set $\mathbf{T}^\star = \{t_0^\star, t_1^\star, \dots, t_{M-1}^\star\}$, where $t_j < t_j^\star < t_{j+1}, j = 0, \dots, M-1$, we reduce the general numerical scheme to the following theorem.

Theorem 1. Set $L'_M = \sum_{j=0}^{M-1} \omega_j F'_{t_j^\star} + \omega_M F'_{t_M}$, where the weights ω_j, $j = 0, ..., M$, are positive, with $\omega_M = 1$. Introduce $R_M = \log(F'_{t_M}/F'_{t_{M-1}^\star})$, $R_0 = \log(F'_{t_0^\star}/F_0)$, and $R_j = \log(F'_{t_j^\star}/F'_{t_{j-1}^\star})$, $j = 1, \dots, M-1$. Set $Y_M := R_M$, and define recursively $Y_j = R_j + Z_{j+1}, j = 1, \dots, M-1$, $Y_0 = R_0 + Z_1$, where $Z_j := \log(\omega_{j-1} + \exp(Y_j))$. Then

$$L'_M \equiv F_0 \exp(Y_0),$$

where the ChF of Y_0 can be found iteratively as follows:

$$\begin{aligned} \phi_{Y_M}(\xi) &= \phi_{R_M}(\xi); \phi_{Z_j}(\xi) = \phi_{\log(\omega_{j-1}+\exp(Y_j))}(\xi), \quad j = M, ..., 1; \\ \phi_{Y_j}(\xi) &= \phi_{R_j}(\xi)\phi_{Z_{j+1}}(\xi), \quad j = M-1, ..., 0. \end{aligned}$$

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