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Fuzzy mortality models based on orthonormal expansion of membership functions

Agnieszka Rossa and **Andrzej Szymański**
University of Lodz, Poland

The new trends in fuzzy analysis are based on the algebraic approach to fuzzy numbers. The essential idea in such an approach is representing the membership function of a fuzzy number as an element of any square-integrable function space. As a starting point we treat the well-known Koissi-Shapiro fuzzy mortality model. We onsider the fuzzy mortality models where the membership function number is strictly monotonic and therefore we can decompose it into two parts: strictly increasing Ψ and strictly decreasing Φ. Then there exist the inverse functions, denoted as f(u)=Ψ-1(u) and $g(u) = \Phi^{-1}$ (u), for u [0, 1] and the couple (f,g) is belonging to the Cartesian product $L^2[0,1] \times L^2[0,1]$. The most frequently used membership functions are triangular functions. Nasibov et al. have applied exponential function to approximation triangular membership functions. Hence, we can get two differentiable functions f and g, defined on the interval [0, 1], and are square-integrable, denoted as $L^2(0,1)$. The scalar product in the space $L^2(0,1)$ is given by the formula $< f, >= \int_0^1 f(u$ g)g(u)du It is commonly known that a set of vectors $\{P_j\}$ in $L^2(0,1)$ is called an orthonormal set if < P_j, P_k >=0 for $j \neq k$ and $< P_j, P_j >= 1$. For an orthonormal set $\{P_j\}$ and for every vector $f \epsilon L^2(0,1)$ we have the following expansion $f = \sum_{j=1}^{\infty} < P_j, f > P_j$. Denoting $a_j =< P_j, f >$ and $b_j =< P_j, g >$ we can transform the membership function μ in a form of the couple (f, g), where $f = \sum_{j=1}^{\infty} a_j P_j$ and $g = \sum_{j=1}^{\infty} b_j P_j$ .The above series can be put into the Koissi-Shapiro mortality model and resolved with respect to the coefficients $\{a_j\}$ and $\{b_j\}$.

Biography

Agnieszka Rossa has completed her Graduation from University of Lodz, Faculty of Economy and Sociology, with specialization in Econometry and completed Habilitation from the same university and faculty. She is a Chair of Department of Demography and Social Gerontology.

agrossa@uni.lodz.pl