

The main objective is elaboration of a new theory of mortality models termed CNMM (Complex Number Mortality Models), which will allow to define a large class of mortality models based on the fuzzy analysis and complex numbers, using existing terminology and introducing new concepts and methods. The research methodology consists both of the analysis of the existing mortality models and the synthesis in one consistent theory of mortality models. The applicative objective of the project assumes application of the CNMM models in mortality forecasting. These forecasts will be then used to calculate future pension annuities to be paid out under the so-called "second pillar" of the Polish pension system.

The main task of the proposed project will be focused on defining the C^* -Banach algebra for modified fuzzy numbers MFN and on formulation of a new type of mortality models termed MFNN (Modified Fuzzy Mortality Model). In the next step, we will consider MFMM using complex polynomials theory. The new class of models based on complex polynomials will be termed CNMM (Complex Number Mortality Models).

Models CNMM will then be employed as basic theoretical tools in mortality forecasting, i.e. in forecasting age-specific mortality rates up to 2050. The period and cohort mortality data available in the Human Mortality Database (www.mortality.org) will be used.

Mortality forecasts will be applied to project the future life-tables and the remaining expected lifetime, what will be a starting point for the scenario analysis of future pension annuities in the so-called second pillar of the Polish pension system, with respect to the pension capital, the year of retirement, minimum retirement age, the rate of return, and the share of charge.

We think that the new mathematical theory of mortality modeling can be useful especially for insurance companies and pension funds, as forecasts of conditional death probabilities and remaining expected lifetimes play the key role in all actuarial calculations. The new methodology can also be applicable in forecasts of the size and demographic structure of a human population.