

BULGARIAN ACADEMY OF SCIENCES  
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Modelling the process of population ageing in Bulgaria  
PhD Thesis

Abstract

The modelling of the process of population ageing is achieved in two directions:

- 1) As a continuous process. The real processes are summarized by continuous mathematical functions. Specific peculiarities of various populations are determined in this way which can be used for analyses and prognoses.
- 2) In discrete form on the bases of real data. Population ageing is modelled as a process, and as state attained by the population at a given moment.

The following scientific results and contributions are achieved in the dissertation:

- 1) A system of indicators for population ageing is constructed based on the stable population model. The indicators are classified in two groups:
  - A. Indicators linked to the reproduction schedule: net reproduction rate; the components of the net maternity function: the fertility function and the survival function; the intrinsic rate of natural growth;
  - B. Indicators linked to age structure: the momentum of population growth; the variations between the equivalent stable and the stationary structures.
- 2) Model for decomposing the dynamics of the net reproduction rate (NRR) is developed based on the index factor analysis. This model is applied for multiplicative and additive decomposition of the NRR of the population of Bulgaria for the period 1960-2009.
- 3) The curves of age-specific fertility rates (ASFRs) of Bulgarian population for the same period are studied, and the dynamics of the ASFRs are decomposed into cohort and period effects.
- 4) A numerical mathematical model is developed for the analysis of the survival curves based on the life table. This model is applied to the analysis of mortality in Bulgaria during the up-cited period.
- 5) The population momentum is used for the research of population ageing. The two components of the population momentum - stable and unstable (after Espenshade et al, 2011) - are applied for the two gender and for each of the five-year age-groups, to characterize population ageing in Bulgaria during the post-war period. This analysis is interpreted in the frame of the demographic transition theory.
- 6) Graphical model is developed for the representation of the components of demographic ageing and demographic burden.
- 7) The results of the calculations on the momentum of the Bulgarian population are used for the analysis of demographic history of the country. During the late stages of demographic transition (since the mid-1940s), the population momentum for the old-age groups attains values over 200%. During the last two decades a dramatic process of modification of the age structure of the population is established, typical for an East-European country.

8) The dissertation results prove an exceptionally rapid process of the demographic ageing. This is typical for an East-European country and it is connected to the lowest-low fertility and to the emigration.

9) Bulgaria is among the countries with the most advanced population ageing. Population projections are provided in the dissertation indicating the long-run effects of the demographic reproduction on the demographic ageing. The effects of these trends on the population structure until 2060 are displayed by the population momentum.

Reference:

Espenshade, T.J., A. S. Olgiati and S. A. Simon A. Levin. 2011. On Nonstable and Stable Population Momentum. *Demography*, 48(4): 1581-99.