

MATHEMATICAL MODELING OF RHYTHMIC COMPONENTS OF TIME PENDING THE SURVIVAL AGE

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Abstract: Presented in the research articles reflect the results of structural-parametric synthesis of the self-organization of algebraic models reflecting the dynamics of the age of survival of human society on the example of the Russian Federation. Presented and analyzed the models of the polynomial type and includes rhythmic components. Analyzed long (67, 82, 132 years) and short (7-8, 11, 22 years) possible periods of dominance of natural rhythms in the dynamics of the considered indicators. It is shown that the dynamics of the survival times of the present: the cycles of Schwabe, Hale, climate, planets Venus and Jupiter, the components of the waves, and the components of the wave Kitchen. The carried out researches allow to assume a decrease in its time of survival in men and to society as a whole against the background of overall growth, due to external natural rhythms.

Keywords: the time pending the survival age, mathematical modeling, rhythmology structure.

The World health organization as indicators of public health in the implementation of the strategy "Health for all in XXI century" highlighted the health and socio-economic indicators, simulation modeling which are important for scientific and practical research. As an integral indicator is proposed to use the "age of survival" is a qualitative analysis and a forecast which allow to correct the social consequences of government intervention in society: retirement age, amount of pension, age and sex structure of the labor potential of the country, etc.

According to statistics in Russia, as the country possessing the integral characteristics of the Euro-Asian social development, the observed dynamics of the age of survival presented in figure 1. Visual analysis suggests rhythmic components.

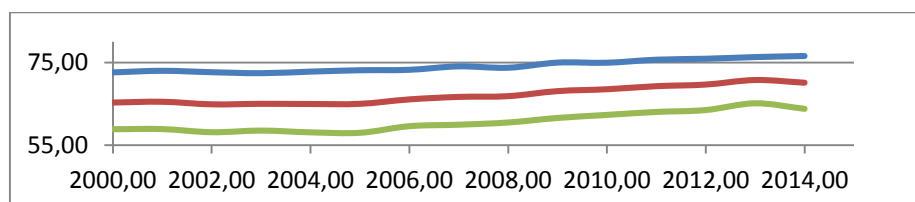


Fig.1 - The Dynamics of the age of survival in Russian Federation ("top-down": women, the entire population, men).

Because the sample size to obtain adequate regression models is not sufficient, it is proposed to apply the self-organizing approach to structural and parametric modeling, characterized by

freedom of choice decision making at the iterative stages of model structures and using various criteria for optimization during synthesis and verification. The concept of self-organization simulation developed by the school of A. G. Ivakhnenko (method of group accounting of arguments – GMDH) and is increasingly used in biomedical research.

The author's use of specialized tools allowed to obtain the mathematical model of the temporal trends of the indicators presented in table 1. (Parabolic structure on the basis of the hypothesis of the dominance of natural cycles were considered as "parts" of harmonic models).

Table 1. Mathematical model ages of survival

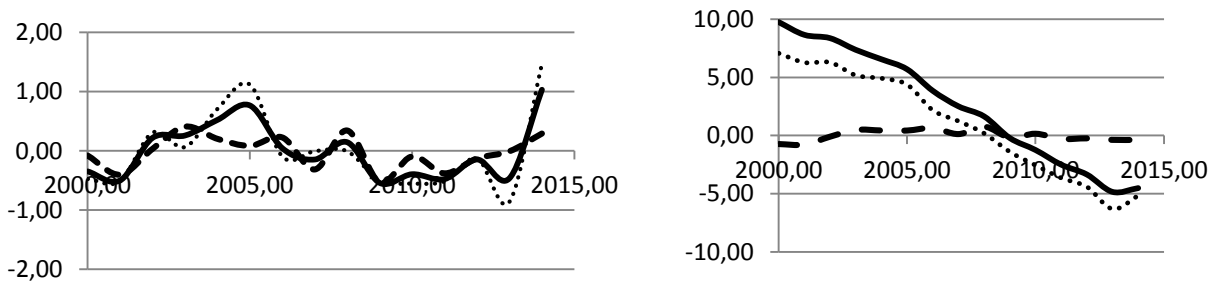
indicator	the polynomial model		the harmonic model		GMDH - model	
	model	R	model	R	model	R
women	$72,51 + 0.019 \cdot t^2$	0,98	$71,55 + 7.09 \cdot \sin(0.0476 \cdot t) ;$ $T = 132$	0,94	$74.09 + 1.58 \cdot \sin(0.46 \cdot t + 5.52)$ $+ 0.38 \cdot \sin(2.05 \cdot t + 5.18) ;$ $T = 13.7; 3.06$	0.78
men	$58,48 - 0.121 \cdot t + 0.038 \cdot t^2$	0,96	$68,87 + 10.48 \cdot \sin(0.094 \cdot t + 3.35) ;$ $T = 66.7$	0,97	$60.48 + 1.56 \cdot \sin(0.56 \cdot t + 5.08)$ $+ 0.48 \cdot \sin(1.55 \cdot t + 5.95) ;$ $T = 11.2; 4.05$	0.47
general population	$65 - 0.057 \cdot t + 0.031 \cdot t^2$	0,97	$77,36 + 12.36 \cdot \sin(0.0767 \cdot t + 3.25) ;$ $T = 81.8$	0,98	$67.57 + 2.73 \cdot \sin(0.28 \cdot t + 5.17) ;$ $T = 22.4$	0.99
women*					$-0.02 + 0.195 \cdot \sin(0.74 \cdot t + 4.55)$ $+ 0.05 \sin(1.44 \cdot t + 2.76)$ $+ 0.145 \cdot \sin(2.45 \cdot t + 2.76) ;$ $T = 8.5; 4.4; 2.6$	0.63
men*					$0.347 \cdot \sin(0.82 \cdot t + 2.02) ;$ $T = 7.7$	0.38
general population*					$0,338 \cdot \sin(0.77 \cdot t + 4.8)$ $+ 0.318 \cdot \sin(2.09 \cdot t + 0.14) ;$ $T = 8.2; 3$	0.73

(*R* – correlation between the values of the approximating function and the interpolation nodes; *T* - is the period in years; "*" denotes the indices after removal of the values of the polynomial models.)

The behavior of temporal trends minus the values of the functions illustrated in figure 2. Thus, it is revealed:

1. For the General population of men "and" the General population" most similar, reflecting the dominance of men in society.
2. The speed of increasing age of survival for men much less than in the General population and about two times more than women.
3. Age survival in women is higher in average than that of men, and has a lower amplitude with higher frequency and more resistant to external rhythmic effects through a better functioning of the autonomous control system.

4. In women, the age of survival is approximated by a cycle of the order of 132 years (the cycle of the planet Venus, six generations). Men's "big loop" is about 66-67 years with a deviation of up to 8 years from the specified harmonics (corresponding to 5-6 periods of solar activity, temperature fluctuations of climate in the North Atlantic, the cycles of the planet Jupiter).



(solid line – the entire population, the dotted – women, point – men)

Fig.2. - The dynamics of ages of survival after removal of the values of parabolic and harmonic patterns

5. Given the General "wave" of increasing age of survival in a General population, men have the tendency to decline (in women - not so expressed).

6. The resulting model suggests the existence of "global rhythms" of about 11 years (Schwabe cycle of the solar activity) and 22 years (Hale cycle of magnetic activity of the Sun) and modulation 4 year cycle (wave Kitchin – economic activity) for absolute figures.

7. With the removal of time-trend values of polynomial models there is a 7-8 year cycle "changes of government" and waves Kitchin that emphasizes the influence of socio-economic factors.

Thus, the studies show promising research in the field of rhythmology analysis of indicators of population health and suggests a decrease in its time of survival in men (compared to the total growth due to natural external rhythms) – possibly due to recent genetic "loss" in the Y chromosome.