The demographic characteristics determine the state and prospects of development of any society. The trends in birth, migration, and death exert a more significant influence on the progress in society than any other established system (social and financial relations, etc.), irrespective of their development level. The objective of the demographic process in Russia for the period until 2025 was defined in the “Concept of the RF Demographic Policy” [1]. According to it, the population size in Russia will constitute no less than 142–143 million people in 2015 and 145 million in 2025. Along with the population size, its gender and age structure is of high importance. Forecasts of its dynamics and the character of its changes in terms of individual areas are practically necessary in all areas of social life.

One of the most important directions in the study of the dynamics of the age and gender structure is predictions of the number and share of the able-bodied population. Before 2002, both in Volgograd oblast and Russia as a whole there was growth in these indicators; then, their stabilization was observed until 2007. Since 2008, the number of able-bodied population in absolute and relative terms has been diminishing. By 2012, the national share of the able-bodied population was 61%; in Volgograd oblast, 60% [2].

Another important direction of investigations of the dynamics of demographic characteristics is predictions of the number of pensioners in the medium- (ten years) and long-term perspective. Without such a prediction, the development of the pension system is impossible.

No reform of school education in the country is possible without knowledge regarding changes in the number of school-age children. It is also necessary to predict the number of preschool children in order to plan a sufficient number of places in preschool facilities.

Thus, simulation of the number and age and gender structure of the population is an important practical task.

The presented scenario simulation of these indicators for Volgograd oblast is based on a probable development version of the demographic situation in Volgograd oblast, namely, changes in the death and birth rates and migration gains of the population.

The methods most often used for the prediction of the age and gender structure of the population are extrapolation, analysis of series, regression analysis, age-specific changes, and expert and probability analyses [3–6].

In this work, the method of age-specific changes is taken. The essence of the method is that every year the population of age \( x \) comes into the age category \( x + 1 \), taking into account the coefficient of death for this age group. In addition, the number of people in an age group changes due to migration. Thus, the number of the population of gender \( s \) of age \( x + 1 \) in year \( t + 1 \) is calculated by the formula

\[
P(x + 1, t + 1, s) = P(x, t, s) \times (1 - Smert(x, t, s)) + Migr(x, t, s),
\]

where \( P(x, t, s) \) is the number of males and females of age \( x \) in year \( t \); \( Smert(x, t, s) \) is the probability of death for this gender–age group in year \( t \); and \( Migr(x, t, s) \) is the migration increment for this age–gender group in year \( t \).

The number of newborn boys and girls is calculated in the following way:

\[
P(0, t, males) = 0.515 \sum_{x=15}^{49} P(x, t, females) \text{rogd}(x, t),
\]
where \( \text{lod}(x, t) \) is the probability of giving birth by a woman of age \( x \) in year \( t \).

Coefficients 0.515 and 0.485 are chosen proceeding from the stable relationship between the numbers of born boys and girls.

To model the dynamics of the age and gender structure of the population in Volgograd oblast, the age and gender structure of the population as of January 1, 2012, was taken as a reference point [7] (Fig. 1).

Currently, the largest population is observed in younger age groups (20–29 years), as well as in the preretirement and early-retirement age group (50–59 years). On the demographic pyramid, the pits are traced: it is the age group 65–69 years (people who were born during the war years), 40–44 years (war children), and 10–14 years (the 1997–2001 period).

In the age groups younger than 30 years, the number of men and boys predominates over the number of women and girls: beginning with an age of 35 years, the number of females gets larger. In the age category “70 and over,” the number of women is 2.23 times more than that of men.

For projecting the dynamics of the structure of the population by the method of age-specific changes, it is necessary to know the function of mortality \( \text{Smert}(x, t, s) \), fertility \( \text{lod}(x, t) \), and migration gain \( \text{Migr}(x, t, s) \). An evaluation of these functions was carried out according to the Territorial Department of the Federal State Statistics Service of Volgograd oblast [7–9; 2].

An analysis of the age coefficients of mortality (number of deaths per 1000 population) in Volgograd oblast for the 1990–2011 period has revealed a stable trend associated with a decreased child death rate (age categories from 0 to 15 years) [2]. Particularly significant the decline in the child death rate was in 2011 (from 17.4‰ in 2000 to 9.2‰). In other age cohorts, these coefficients increased in the period from 1990 to 1994, and then decreased up to 1998 and then increased again up to 2003. Since 2004, there has been a tendency towards their decline in all age cohorts. This same dynamics is also demonstrated by the total mortality coefficient (Fig. 2).

In modeling the dynamics of the age and gender structure, two scenarios were considered. The first one (pessimistic) is that the death rates remain at the 2011 level in all age and gender cohorts. The other (optimistic) scenario is that the death rates in all gender and age cohorts decrease. For projecting the dynamics of the decrease in death rates in each age–gender group, exponential trends were calculated using dates from 2004. The exponential trend is

\[
y(t) = b(t) e^{a(t)},
\]

where parameter \( a \) shows the relative rate of increase (decrease) in the indicator and parameter \( b \) is the initial value of the series.

Table 1 shows for each age and gender cohort the death rates in 2011, relative death rate reduction, and their predicted value until 2030, obtained by an exponential model.

If the decrease in the relative death rate is maintained at the calculated level, by 2030, it will reach values typical of developed countries [10]. Thus, in the projection of the changes in the population structure, we assume that until 2030 the death rate function is determined in the following way:

\[
\text{Smert}(x, t, s) = b(x, s)e^{a(x, s)(t-2011)},
\]

where \( a(x, s) \) and \( b(x, s) \) are the parameters of the exponential trend for the appropriate age–gender group. In long-term forecasts, we will accept that the death rates will stabilize at the 2030 level. The age–gender mortality rate in the original year of 2011 is shown in Fig. 3.