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Demographic Tendencies, Age Structure Pyramid and Demographic Forecast of the Republic of Uzbekistan

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Abstract: This article presents research-based forecasts, proposals, and conclusions derived from demographic trends in the Republic of Uzbekistan. It includes statistics on birth rates, mortality, and migration processes, as well as data on the population's age structure. The study clearly demonstrates significant changes in the gender and age composition of the population of the Republic of Uzbekistan, along with a notable increase in overall population numbers. It has been shown that population growth in the Republic of Uzbekistan is linked not only to population aging, but also to the uneven development of its age structure. Throughout the forecast period, there is a general trend towards the transition of identified inequalities in the age structure of the population to the elderly.

Keywords: Birth, Death, Migration, Age Structure Statistics, Forecast, Demography, Economy, Population, Strategy, Demographic Pyramid, Population Growth, Decline

1. Introduction

The efforts of society aimed at increasing the efficiency of social development management presuppose not only a response to a particular situation by eliminating or mitigating undesirable phenomena, and in some cases even adaptation to it. These efforts, first of all, include understanding, planning and timely implementation of measures designed to ensure the sustainable development of society in the right direction. If we proceed from the fact that the measures taken should be based on certain well-thought-out principles, then, due to their orientation towards the future, they should be based, first of all, on the results of forecasts, i.e. realistic, scientifically substantiated ideas about the future development of certain fragments of social reality.

Demographic development, which is expressed in changes in the number and age structure of the country's population, is determined by the initial distribution of the population by gender and age, as well as the processes of birth, mortality and migration. It should be noted that a number of circumstances, including changing migration intensity, relatively low reliability of emigration statistics, high and, in addition, fluctuating birth rates over the past twenty years, as well as incompletely studied demographic consequences of the COVID-19 pandemic and current socio-political and economic instability in the world, have significantly complicated the analysis and forecasting of the country's demographic development. In the case of regional forecasts for individual administrative-territorial units, the situation was further complicated by

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the adjustment of the population of the Republic of Uzbekistan carried out during the 2010 sample census. A one-time increase in the population by more than 0.6 million people violated the possibility of data comparability over time[1].

The above situation determined not only the approach to solving research problems, but also the choice of methods that were used at various stages of forecast development. When performing each forecast, internationally recognized principles and methodological recommendations for developing population forecasts were mandatory observed. In addition, given the existing differences in the reproductive behavior of the population of individual administrative-territorial units, their demographic development was analyzed and forecasted separately. The forecast results for the entire country were obtained by combining the results of regional forecasts.

In making the forecasts, the already classical cohort-component method (age shifting method) was used, which allows us to consider demographic reproduction as a complex process that includes four relatively autonomous subprocesses or components of reproduction: fertility, mortality, immigration, and emigration. Based on the results of the analysis of these components and the currently available empirical and theoretical knowledge, forecasting assumptions were formulated for each of these processes, which were subsequently used to determine the values of the parameters of the forecast model. The aggregate forecast was created by repeatedly using the forecast model, within the framework of which the forecasted indicators of the intensity of the fertility, mortality, and emigration processes, as well as the number of immigrants by sex and age, were repeatedly applied in one-year increments to the corresponding age and sex structures. As a result, the numbers of men and women were obtained, broken down by age and region of residence by the end of each calendar year of the forecast period.

Literature review

In the early years of population demography development, the city and attention was paid to urban settlements. O.A. Konstantinov, V.V. Pokishevsky, Yu.G. Saushkin, later V.G. Davidovich [2] and others made important contributions to urban studies. Har N.L. Lyalikov gave a description of the location of rural residents was published for the first time in the late 40s. Next, this S. A. Kovalev entered the field with his great efforts came His typology of rural settlements, specific methods in the location of the rural population, the rural population a number of directions in the system of addresses are among them. Study of population migration by V.V. Pokshishievsky It started and is still important in population geography has been occupying a special position as a direction 0 about population and population settlements in the territory of Uzbekistan information is available in sources in ancient manuscripts.

Population researches in the direction of geography 0 in Uzbekistan XX -started improving from the second half of the year. N. Ginzburg, G. Kovalev, O. Ata-Mirzaev, A. Soliev, Kh. Salimov, A. Qayumov, Scientists such as Z. Rayimjonov, L. Safarov, M. Borieva, Z. Tojjeva[3] were brought Some of the researches that have been conducted are among them. In the studies mentioned Geography and formation factors of cities in the republic, urbanization process, population settlements in rural areas features of formation, location, geography of labor resources problems related to.

2. Materials and Methods

The research on the topic "Demographic tendencies, age structure pyramid and demographic forecast of the republic of Uzbekistan" used deduction and induction methods, analyzing from the general to the specific and vice versa. Abstract-logical thinking helped to systematically study economic changes in the region. Structural change processes were analyzed in depth through observation, generalization, grouping and comparison methods. Synthesis and analysis methods were used to identify the causes and economic impact of changes. This methodology achieved clear and reliable research results.

3. Results and Discussions

The population is the basis of economic, social and political reforms for each country, as well as the development of the economy is to serve the population's well-being. In our country, population growth or decline, the number of men compared to women, the number of people in urban areas compared to the number of people in rural areas, labor migration, demand and supply in the labor market, unemployment problems, poverty reduction, distribution of limited resources per capita allow to identify economic, social and political issues in the future and develop reforms, strategies and concepts. While the population of the world is growing, the population of Uzbekistan is increasing as well, and occupies the 43rd place in the world with 37355.4 million people as of January-September 2024, the birth rate is 25.0‰ and natural growth is increasing by 562,223 thousand people. Short-, medium- and long-term demographic forecasts of the population are extremely important for every country, because it is necessary to develop economic and political strategies of the state in relation with demographic trends. For instance, as a result of the decrease in the birth of the population, the probability of extinction of the nation in many countries by the year 2050 or 2100, or the correct distribution and rational use of natural resources limited by the high birth rate, is one of the tasks of every country.

To realize the will of our people to build a free and prosperous, powerful New Uzbekistan, to create all the opportunities for every citizen to develop their potential, to raise a healthy, educated and morally mature generation, the President of the Republic of Uzbekistan signed a Decree № PF-158 on September 11, 2023 On the Strategy of “Uzbekistan – 2030”, in order to form a strong economy, which has become an important link of production, and guarantee justice, rule of law, security and stability, as well as target strategic development indicators for 5 priority directions was approved. All five priorities serve the population, and the first priority is “creating decent conditions for everyone to realize their potential” and the second one is “ensuring the well-being of the population through sustainable economic growth” serves for the economic and social support, and comfortable living of the population on the development of human capital[4].

Each country has long-term and short-term development strategies. In the development of these strategies, it is significant to determine the statistics of the age structure of the population, and in the future, determining the need for schools, medical institutions, services and limited natural resources in relation to the population is one of the important tasks of our state, playing an important role for making socio-economic and political decisions. The composition of the 8-15 age group is the highest in our country, which means that it is necessary to identify the needs or problems of this age group in the future in our country. For example, the lack of school facilities or sports complexes in urban and rural areas.

The development of the population of Uzbekistan is characterized not only by a significant increase in its growth rate, but also by significant changes in the composition of age and gender.

Since more boys are born than girls, a certain imbalance in favor of males can be seen in the composition of the young age population. In the modern Uzbek population, the ratio of men to women decreases around the age of 40 (Figure 1), and women predominate in old age. At the same time, the increase in the number of women over men in the total population increases with age, especially after reaching the age limit in the age group of 65 years and above.

Based on the current values of almost all indicators used to measure the age of the population, the age structure of the population of Uzbekistan can be considered as “young”. The average age of the population is 27 years, which means that half of the country's population is under this age, and the share of children, i.e., those younger than working age (0-15 years), is about 31 percent.

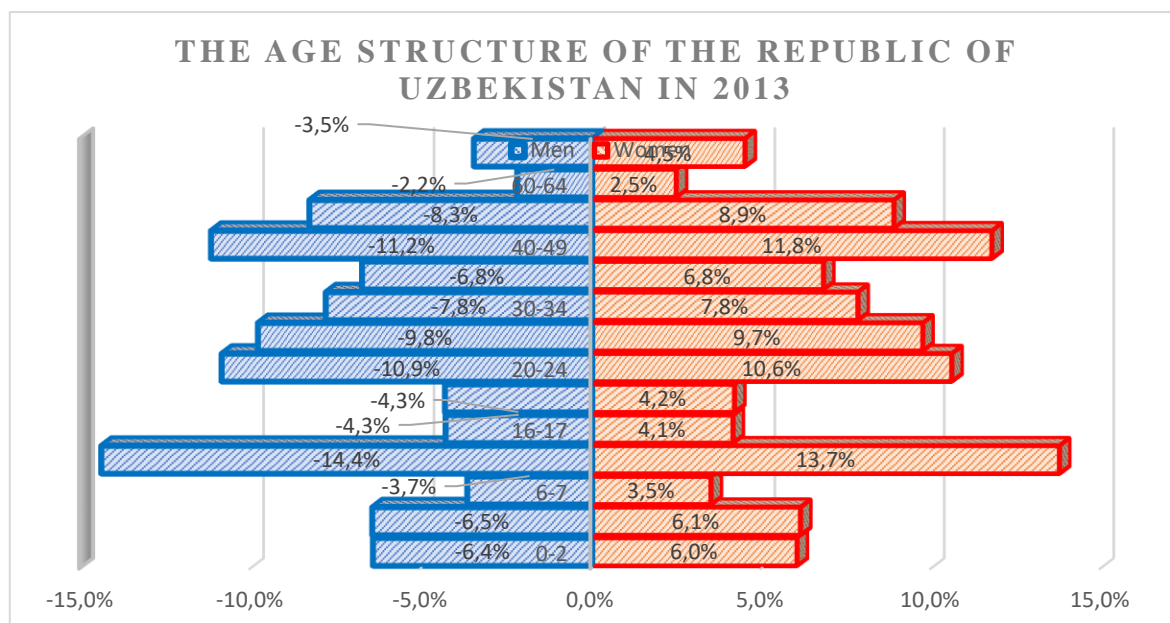


Figure 1. Author's implementation based on statistical data

The age structure in the Republic of Uzbekistan in 2023 partially differs from that of 2013 due to the increase in the birth rate (Figure 2). The average age of the population in 2023 is 28.5 years for men and 30 years for women, the share of people under the working age (0-15 years) is about 32.7%, the working-age population (16-55 years) is 55.7%, and those under 60 and the population older than that reached 11.6 percent (Figure 2).

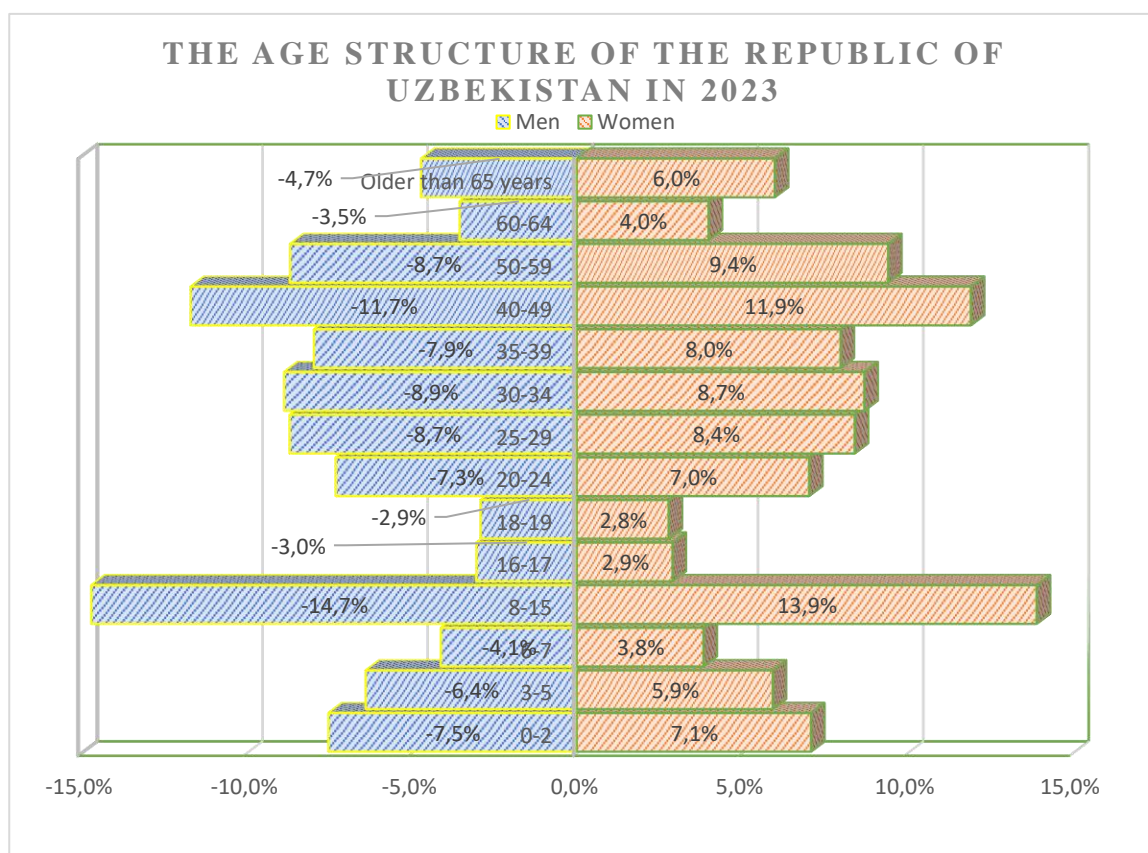


Figure 2. Author's implementation based on statistical data [5]

When analyzing the composition of the permanent population of the Republic of Uzbekistan in 2023 by gender and age groups, among men and women, children aged 8-15 years had the highest percentage, i.e. 14.7%, while women made up 13.9%. The smallest population among men and women is 2.9%, corresponding to the share of 18-19-year-olds.

As can be seen in the figure, the population of Uzbekistan has continued to age, showing changes in age and gender composition over the past ten years. Although the aging process occurs mainly from the top, it has partially affected the middle and young age groups of the population. In the total population, not only the share of people over 60 years old, but also the share of the 30-49 age group has increased, i.e. the proportion of persons older than the average age of the population at the time of observation. As a result, the average age of the country's population increased from 28.0 years to 29.6 years in 2013-2023.

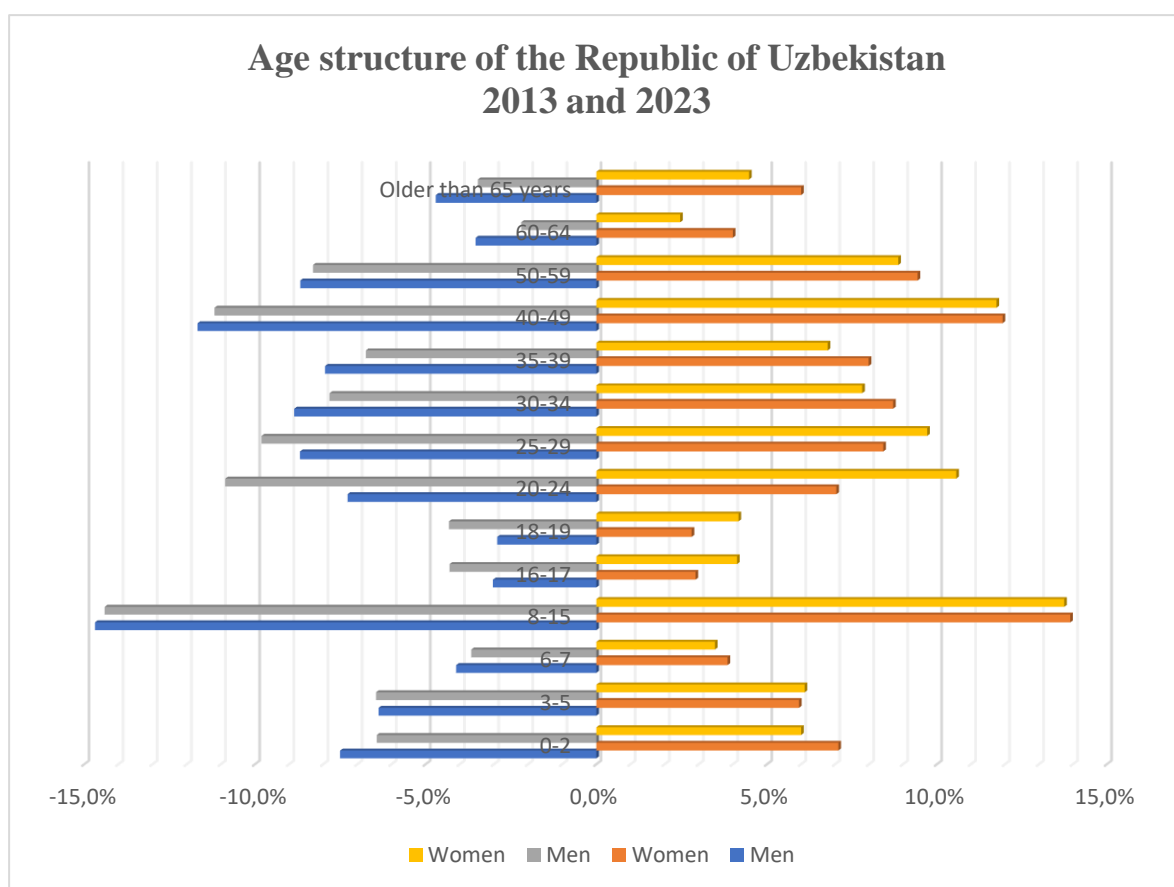


Figure 3. Author's implementation based on statistical data [6]

Comparing the years 2013 and 2023, the age structure in 2023 only increased from age groups 0-2, 6-7, 8-15, 30-34 to 65 years and adults, as well as 3-5, 16-17, 18-19, 20-24, 25-29 age groups mentioned a decrease compared to 2013.

Due to the continued aging of the population of Uzbekistan and its regions, it can be expected that the impact of the death process on the reproduction of the country's population will increase. From 2001 to 2021, the number of deaths increased from less than 133 thousand to 175 thousand. Note that the 2021 death toll includes excess deaths directly or indirectly related to the COVID-19 pandemic. From 2000 to 2023, there was a steady increase (with small fluctuations) in life expectancy at birth. For men, this indicator increased from 67.3 to 72.4 years, and for women from 72.4 to 76.5 years, i.e. 5.1 and 4.1 years, respectively.

It clearly illustrates significant changes in the gender and age structure of the population of the Republic of Uzbekistan and a significant increase in their number. It can be seen that population growth in the Republic of Uzbekistan will be related not only to

the aging of the population, but also to the uneven development of its age structure. During the entire forecast period, there is a general tendency of the identified inequality in the age structure of the population to shift to the elderly. (Figure 4).

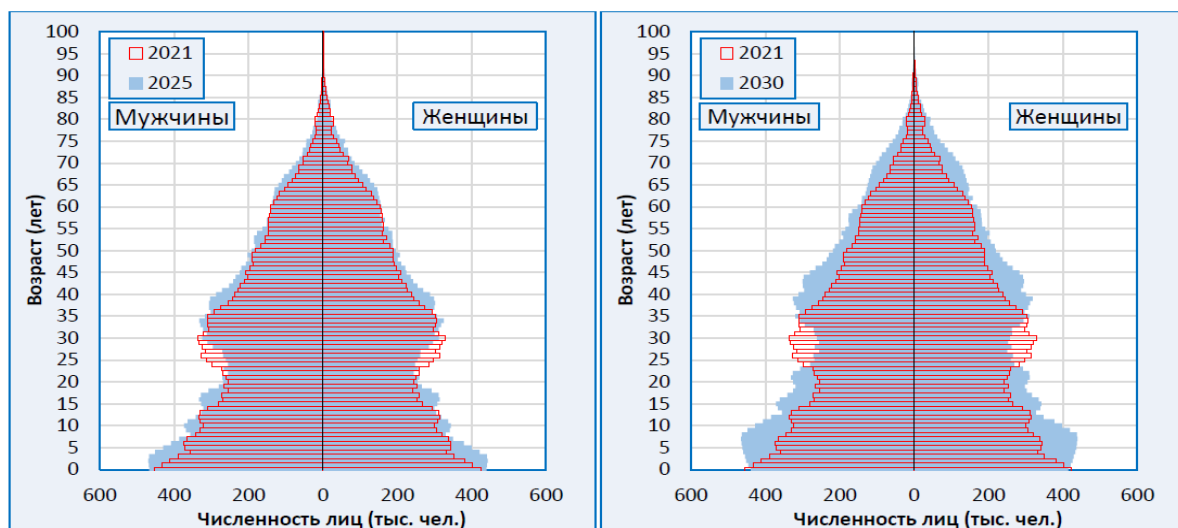


Figure 4. [7]

According to the forecasts of the age structure, in 2025-2030, the population growth in our country, as well as the life expectancy of the population, are increasing. In the last 10 years, during the period of rapid growth of birth intensity, the peak is between 22 and 24 years old, and this age-related birth pattern is largely the result of the preservation of the traditional marriage model in Uzbekistan. However, according to forecasts, the maximum birth rate will shift to the 25-29 age group. In 2030, the 5-10 age group will have the highest rate, the average life expectancy is projected to increase from 74 to 78 years, and the 25-30 age group is predicted to decrease in 2030.

Demographic forecasting using Arma model. In statistics and signal processing, the autoregressive moving average (ARMA) model, sometimes called the Box-Jenkins model, is used to study time series[8].

Given a time series X_t , the autoregressive moving average model can explain and possibly predict the future values of the series. The model consists of two parts: an autoregressive (AR) part and a moving average (MA) part. The model is usually called ARMA(p, q), where p is the order of the regression part and q is the order of the moving average.

The combination AR(p) is used to specify an autoregressive model of order r. AR(p) is written as:

$$X_t = c + \sum_{i=1}^p \phi_i X_{t-i} + \varepsilon_t$$

Here: $\phi_1, \phi_2, \dots, \phi_p$ are model parameters, c is a constant, ε_t is white noise. The constant is often omitted for simplicity.

In essence, an autoregressive model is a polar filter with an infinite impulse response interpreted in the context of time series analysis. In order for the model to be stationary, some constraints on the model parameters are required. For example $|\phi_1| \geq 1$ for the AR(1) model will not be stationary.

The model of moving average order q is denoted by MA(q) and written as follows:

$$X_t = \sum_{i=1}^q \theta_i \varepsilon_{t-i} + \varepsilon_t$$

where $\theta_1, \theta_2, \dots, \theta_q$ are model parameters and $\varepsilon_t, \dots, \varepsilon_{t-q}$ are errors.

A moving average can be seen as an interpretation of a finite impulse response filter. Autoregressive moving average: ARMA(p,q) is a model containing p autoregressive components and q moving averages. Specifically, the ARMA(p,q) model includes the AR(p) and MA(q) models:

$$X_t = c + \varepsilon_t + \sum_{i=1}^q (\theta_i \varepsilon_{t-i} + \phi_i X_{t-i})$$

Usually, the error values ε_t are taken as independent uniformly distributed random variables drawn from a normal distribution with mean zero: $\varepsilon_t \sim N(0, \sigma^2)$, where σ^2 is the variance.

Assumptions can be relaxed, but this may change the properties of the model. For example, if we do not assume independence and the same distribution of errors, the behavior of the model changes significantly.

Another definition of the ARMA model is also possible, where the L lag operator can be used. In this case, the autoregressive model is given by the formula AR(p).

$$\varepsilon_t = \left(1 - \sum_{i=1}^q \phi_i L^i\right) X_t = \phi X_t$$

Here: ϕ -polynomial

$$\phi = 1 - \sum_{i=1}^p \phi_i L^i$$

The MA(q) model is given as follows:

$$X_t = \left(1 - \sum_{i=1}^q \theta_i L^i\right) \varepsilon_t = \theta \varepsilon_t$$

Here: θ - polynomial

$$\theta = 1 - \sum_{i=1}^p \theta_i L^i$$

Finally, the ARMA(p,q) model is described by the formula:

$$\left(1 - \sum_{i=1}^q \phi_i L^i\right) X_t = \left(1 - \sum_{i=1}^q \theta_i L^i\right) \varepsilon_t$$

or shortly:

$$\phi X_t = \theta \varepsilon_t$$

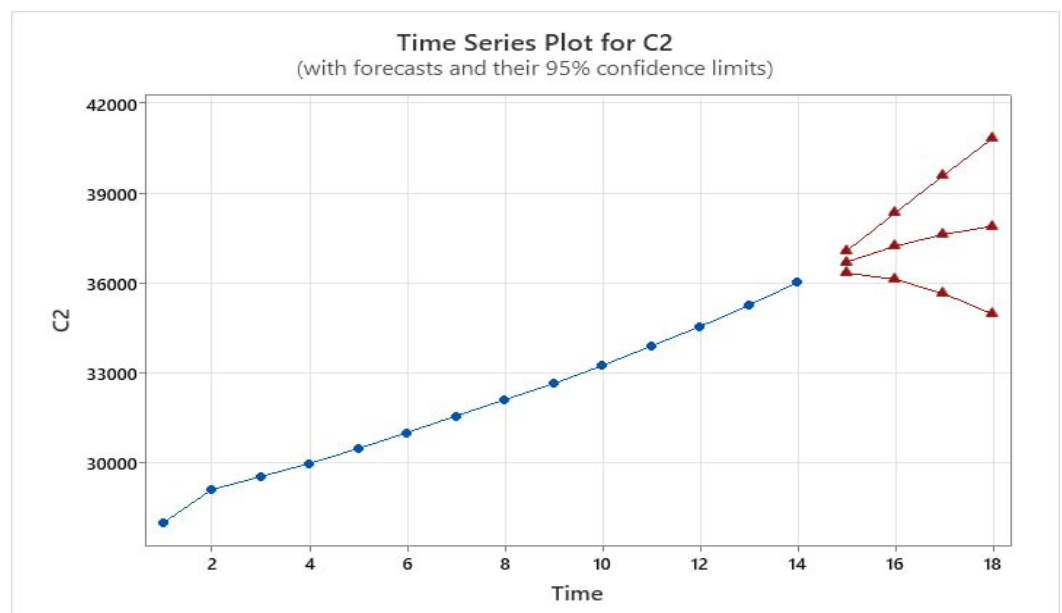


Figure 4. The author's implementation based on statistical data of the Statistics Agency under the President of the Republic of Uzbekistan [7]

According to the forecast, the population of the Republic of Uzbekistan will grow rapidly for the next three decades. Most likely, by 2028, the number of the population of Uzbekistan is predicted to be close to 40.8 million at the highest, 39.0 million at the average, and 38.0 million at the minimum. By 2050, this figure is expected to increase to 50 million. In this case, natural growth will be the decisive component of the total population birth during the forecast period. In addition to the rapid growth of the population, profound changes are taking place in all age structures. At the same time, the rate of population aging is expected to increase[8].

The following result was obtained when predicting the demographic forecast using the MINITAB program (Figure 6).

Forecasts from Time Period 14

				95% Limits	
Time Period	Forecast	SE Forecast	Lower	Upper	Actual
15	36708,2	185,16	36345,2	37071,2	
16	37238,3	563,50	36133,7	38343,0	
17	37632,6	1008,88	35654,8	39610,4	
18	37906,4	1495,20	34975,3	40837,6	

Figure 6. The author's implementation based on statistical data of the Statistics Agency under the President of the Republic of Uzbekistan

According to the results of the forecast, the largest population growth will be observed in 2025. The confidence level of the population forecast is 95 percent. Of course, there are the following factors that influence demographic trends:

- a) State demographic policy
- b) Reproductive health
- c) High or low human capital
- d) Population income and employment problems and so on.

According to the results of the analysis based on the forecast and the theoretical developments in the studied area, it can be said with great probability:

- a) A significant increase in the total fertility rate observed in the last five years is a temporary phenomenon. An assessment of the development prospects and the current situation of the factors affecting the dynamics of fertility (for example, the increase in the coverage of young people) is indicated.
- b) Death rates will return to pre-COVID-19 levels and gradually decline in the future, leading to increased life expectancy for both women and men.
- c) Internal and external migration will increase. At the same time, there is an increase in the migration balance. After reaching the expected level (depending on the forecast option), it is assumed that the values of these indicators will remain stable.

The results of the forecast allow us to draw the following conclusions:

- 1) The population of the Republic of Uzbekistan will grow rapidly and will exceed 40.8 million people by the end of 2028.
- 2) Such population growth is observed in all 14 regions of Uzbekistan.
- 3) Important changes will occur not only in the size of the population, but also in the age structure - the aging process of the population will be accelerated and long-term.
- 4) The average age of the country's population will increase significantly by 2028 (from 29.8 to 31.0 years).

- 5) Forecast of age groups, for example, in 2028, 2040 and 2050, there will be an unprecedented increase in the number of people over 65 years old. The rapid aging of the population will inevitably raise new problems, including the issue of ensuring the stability of the pension system. It can be assumed that the first important step towards the reform of the pension system will be to increase the current, relatively low retirement age. The growth of the elderly population and the increase in the average life expectancy lead to an increase in the demand for the services of health institutions. This, in turn, leads not only to a significant increase in the costs of providing medical services to the population, but also to serious changes in the composition of the costs of the elderly population and their households. The change in the demographic composition of the population is also reflected in the increase in the demand for social services.
- 6) Expected changes in the reproductive parameters of groups and working-age population up to the age of 0-14 are related to various spheres of the state and society, in particular, social protection of the population and provision of social services, health care, labor market and employment provision will undoubtedly have a significant impact on such areas. In addition, the situations developing in these regions under the influence of demographic factors may be interconnected - a change in the existing situation in one region may lead to a change in another region [16].
- 7) Demographic trends have an important impact on various spheres of state and society, such as regional development, production, industry, agriculture, construction, transport, communication, investments, services, health, education system, labor market and employment, social protection and social services.
- 8) Every economic, social and political reforms, development of strategies, concepts, and decision-making, development of short-term and long-term programs, serve for the well-being of the population, as well as in solving, identified existing or potential problems. In order to ensure the cooperation of state bodies and to increase the consistency of their actions, it is necessary to identify the state bodies that take the initiative within the powers and authorities given to them and to assume the main responsibility for ensuring stable demographic development [17].

4. Conclusion

This set of population forecasts for the territory of the Republic of Uzbekistan and its 14 territorial-administrative units was developed taking into account specific conditions and preliminary data available at the beginning of the forecast period. Therefore, all presented forecasts, as well as performed analytical and predictive studies have their own substantive and methodological features. These characteristics were due to a number of factors, including the relatively poor knowledge of population development at the national and regional levels. Some of the associated difficulties have been overcome during the forecasting process, but a number of issues still await resolution [18]. It is obvious that the expected changes in the parameters of population reproduction will have a significant impact on various spheres of the functioning of the state and society, such as production (industry, agriculture, construction, transport, communications), investment, services, public health, education system, labor market and employment, social protection and social services for the population, etc., as well as regional development.

Moreover, the situations that develop in these spheres under the influence of demographic factors can be interconnected and interdependent - a change in the current situation in one sphere can entail a change in another.

The growth of the birth rate and mortality (especially among men of working age), the dynamics of the population under working age (0-14 years) actualize the issues of

maternal and childhood protection, public health, the formation of favorable living conditions, as well as the development of the education system, including preschool [19].

The working-age population, which represents the potential labor force, will steadily grow throughout the forecast period and at the same time "age". In this regard, one of the key tasks will be the creation of adequate jobs for the growing working-age population [20]. The importance of solving this problem is determined, firstly, by the expected large-scale growth in demand for jobs, and, secondly, by the existence of a close relationship between the dynamics of the employment sector and the development of other areas of public life.

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