

Methodological Aspects of Statistical Research of Population Demographic Processes

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Abstract: Abstract: This article comprehensively analyzes the theoretical and methodological aspects of the statistical research of demographic processes within the population. The study thoroughly covers the main statistical indicators and advanced analytical methods used to assess crucial factors such as birth rates, mortality, migration flows, and structural changes in the overall population. Based on the official demographic indicators of the Republic of Uzbekistan in recent years, detailed territorial, regional, and dynamic analyses are carefully carried out. Furthermore, the intricate relationship of these demographic processes with the socio-economic development and stability of the country is deeply investigated and shown. The results of the study emphasize that population dynamics directly influence labor market trends, social welfare programs, and economic sustainability. Consequently, these findings are of great practical and academic importance in improving regional demographic statistics and forming a scientifically based, comprehensive national demographic policy. This research provides valuable insights for policymakers and economists to predict future population growth patterns and address emerging challenges effectively.

Keywords: population demography, demographic processes, statistical analysis, birth, death, migration, demographic indicators, territorial analysis.

1. Introduction

In today's conditions of globalization and rapid socio-economic changes, statistical research of demographic processes of the population (birth, death, marriage and divorce, migration, urbanization, shifts in the age and sex composition of the population) has become one of the most important areas of scientific substantiation of state policy. Any change in demographic dynamics directly affects the labor market, the burden on the education and healthcare system, housing and infrastructure planning, social protection, and territorial development strategies. Therefore, it is urgent to study demographic processes not only through descriptive indicators, but also in a causal relationship using modern statistical approaches.

The methodological basis of demographic statistics is, first of all, to ensure the reliability and comparability of data. In practice, data on demographic processes are usually formed from sources such as population censuses, civil status registers, migration accounts, sample observations, administrative registers and territorial statistical reports. Based on these sources, a system of indicators is used to measure demographic phenomena: general and special birth rates, death rates, infant mortality, natural growth, marriage-divorce rates, migration balance, urbanization level, age-sex pyramid, demographic load coefficient, etc. In this regard, methodologically important issues are such approaches as standardization (by age), compilation of a demographic table (life table), cohort analysis, separation of trends and seasonality, demographic forecasting (cohort-component method), assessment of the influence of factors by regression and decomposition methods.

The article covers these methodological aspects of the statistical study of demographic processes: the correct selection and interpretation of indicators, checking the quality of data (completeness, duplicate entries, late registration), the need for standardization when comparing across regions, and the methodological possibilities of compiling short- and medium-term forecasts are analyzed. At the same time, the assessment of demographic changes in relation to socio-economic factors (income, employment, education level, health indicators, housing conditions, urbanization), and the demonstration of the effectiveness of demographic policy based on statistical criteria also increase the practical significance of the article.

It is worth noting that as of January 1, 2025, the permanent population of the Republic of Uzbekistan was 37.5 million (37,543.2 thousand) people[1].

This figure indicates that demographic growth is continuing and reinforces the need for methodologically in-depth statistical analysis of population structure and renewal processes (birth–death–migration rates, territorial density differences, shifts in age structure).

2. Literature analysis

The issues of statistical research of population demographic processes are widely covered in foreign and domestic scientific literature, and this area mainly covers research aimed at improving the formation of demographic indicators, methods of their analysis, and forecasting methodology.

The concept of demographic growth and life tables, developed by A.J. Coale and P. Demeny, forms the methodological basis of demographic statistics. Their research proposed methods for standardizing mortality and fertility processes, taking into account the age-sex composition, and this approach is still used today as a classical basis for demographic analysis[2].

DS Preston, P. Heuveline and M. Guillot in their work “Demography: Measuring and Modeling Population Processes” pay special attention to the issues of statistical modeling of demographic processes. The authors made a comparative analysis of cohort and period approaches to determining birth and death rates and proposed methods of estimation in conditions of inaccurate statistical data[3].

W. Lutz, SKC KC and J. Goldstein, in their studies on demographic forecasting, further developed the cohort-component method and scientifically substantiated the need to include the factor of the level of education of the population in forecast models. This approach allows analyzing demographic processes inextricably linked to socio-economic development[4].

Bongaarts developed a model of proximate determinants for the statistical study of fertility. This model increases the accuracy of demographic analysis by statistically isolating factors that directly affect the fertility process (marriage, contraception, birth spacing)[5].

The methodological guides and World Population Prospects reports prepared by the United Nations Population Division are an important source for comparative statistical analysis of global demographic processes. These studies propose common standards, indicators and forecasting scenarios for international comparison of data[6].

In the domestic scientific literature, the statistical study of demographic processes is mainly covered in connection with the characteristics of the socio-economic development of Uzbekistan. In particular, K. Abdurakhmonov, in his research, analyzed the processes of population renewal in close connection with the labor market and employment indicators, and revealed the economic significance of the demographic load coefficient based on statistical methods[7].

Also, in his scientific work on demographic statistics, R. Alimuhamedov studied regional differences in birth and death processes and substantiated the importance of relative indicators, indices, and dynamic series analysis in their assessment. The author emphasizes the need to combine official statistical data with sample observations in assessing demographic processes in the conditions of Uzbekistan[8].

In addition, ASSodikov's scientific work is devoted to the issues of long-term forecasting of changes in the size and composition of the population, in which the possibilities of using the cohort-component method in national statistical practice are shown. This approach is of significant scientific and practical importance in planning demographic policy at the regional level[9].

In general, research by foreign and domestic scientists shows that the correct choice of indicator system, the coherence of methodological approaches, and the accuracy of forecasting methods are of crucial importance in statistical research of population demographic processes. These scientific views constitute the theoretical and methodological basis of the research conducted in this article.

3. Methodology, discussion and results

In this study, the statistical study of population demographic processes is carried out on the basis of official statistical data. The information base of the study is the indicators published in the Statistical Committee of the Republic of Uzbekistan, the UN Department of Population (UN DESA), and open demographic databases. The main analysis period covers the demographic dynamics of recent years.

The research process uses general scientific and special statistical methods. In particular, when assessing demographic processes, absolute and relative indicators of birth, death, natural growth,

marriage and divorce, and migration are considered. In order to ensure comparison across regions and time, dynamic series analysis, structural analysis, and age standardization methods are used.

Also, the cohort approach and the demographic loading coefficient are used to determine changes in the population structure. Trend analysis and simplified forecast elements are used to assess the trends of demographic processes. The results are summarized in graphical and tabular form, and the relationship of demographic processes with socio-economic development is statistically explained.

In recent years, demographic processes have been characterized by complex and multidirectional trends both globally and in the Republic of Uzbekistan. The results of the study show that demographic changes are now manifested not only in terms of population growth or decline, but also in terms of shifts in population composition, territorial distribution, migration flows, and age structure.

World experience shows that in most developed countries, the main demographic problem is the decline in the birth rate and the aging of the population. In the European Union countries, Japan and South Korea, the total birth rate is below the replacement level, which leads to a reduction in labor resources and an increase in the burden on the social security system. Therefore, demographic policies in these countries are aimed at supporting families, encouraging female employment, and replenishing labor resources through migration.

In developing countries, on the contrary, rapid population growth and accelerated urbanization processes are observed. High fertility rates in Asian and African countries are creating additional pressure on education, health care and employment systems. At the same time, the increase in international migration is having a significant impact on the global demographic balance. As a result, it is becoming increasingly important to fully take into account migration flows and use comparable indicators in statistical analysis of demographic processes.

Another important trend at the global level is the widespread introduction of demographic forecasting and numerical statistical methods. Forecasting models developed by the UN and other international organizations are based on the cohort-component method and take into account age, gender, and education levels in a comprehensive manner. This makes it possible to link demographic processes with long-term strategic planning.

The results of the study show that the Republic of Uzbekistan has been experiencing stable demographic growth in recent years. The increase in the population is mainly due to a high birth rate and positive natural growth. At the same time, the high share of young people in the population is an important demographic advantage for the country. This situation, while having a positive impact on the labor market, education system and economic growth potential, also reinforces the need to ensure employment and increase investments in human capital.

Territorial analyses show that demographic processes are not uniform across the republic's regions. While some regions have high birth rates, others are experiencing population changes due to migration. This confirms the need to use territorial and structural analysis methods when assessing demographic indicators, not limited to average values.

Social and institutional reforms implemented in the republic in recent years have a direct impact on demographic processes. In particular, the modernization of the healthcare system and the expansion of maternity and childhood protection programs are contributing to a decrease in mortality rates. Reforms in the education system are creating the basis for the qualitative development of the younger generation, which in the long term will lead to an improvement in demographic indicators.

Analysis of migration processes shows that external labor migration still remains an important factor. However, in recent years, internal migration and urbanization processes have intensified, leading to an increase in population density in large cities and industrial centers. This situation requires the widespread use of demographic statistical analysis in planning housing, transport and social infrastructure.

Statistical research of demographic processes of the population is a complex and multifaceted scientific process, which requires methodologically sound approaches. First of all, the information base of such studies should be based on reliable and comparable statistical data. Data on demographic processes are usually formed on the basis of population census results, civil status records (births, deaths, marriages and divorces), migration accounts, selective socio-demographic observations, and

administrative registers. The completeness and coherence of these sources determine the reliability of the results of demographic analysis.

The formation of a system of indicators is of particular methodological importance in the statistical study of demographic processes. In the research process, along with absolute indicators such as population size, birth and death rates, relative and special indicators such as general and age-specific birth and death rates, natural growth, marriage and divorce intensity, and migration balance are used. These indicators allow for a deep and systematic analysis of the processes of population renewal.

When comparing demographic indicators across regions and time periods, it is necessary to take into account differences in age and gender composition. Therefore, direct and indirect standardization methods are used in statistical research to ensure comparability of indicators. In this case, reliance on a standard population structure allows for an objective assessment of demographic processes.

The time factor is an important feature of demographic processes, and dynamic series and trend analysis are widely used in their study. These approaches identify long-term trends in demographic indicators, the degree of stability, and the rate of change. At the same time, structural analysis serves to identify changes in the age, gender, and urban-rural population composition of the population, and territorial analysis allows us to reveal the causes of demographic imbalances.

The cohort approach is one of the important methodological foundations in demographic research. This method allows us to identify generational differences in birth, death, and migration processes by observing specific birth cohorts over time. The results of cohort analysis are important in justifying demographic policy in the long term.

Also, in assessing demographic processes from a probabilistic point of view, indicators such as life tables, survival probabilities, and average life expectancy are considered. These methods serve to statistically analyze changes in population health and life expectancy. In the statistical study of migration processes, indicators such as inflow and outflow flows, migration intensity, and migration balance are used to assess their impact on demographic composition.

Forecasting methodology plays a special role in the in-depth analysis of demographic processes. Forecasts based on the cohort-component method allow taking into account various scenarios (inertia, optimistic and pessimistic) and serve to predict changes in the population size and structure in the future on a scientific basis. In addition, correlation, regression and decomposition methods are used to determine the relationship of demographic processes with socio-economic factors.

At the final stage, it is important to interpret and visualize the results of statistical analysis in a scientifically sound manner. The results obtained are presented in a clear and understandable form using tables, graphs, demographic pyramids and cartographic images. At the same time, the use of research results in accordance with international statistical methodologies, in particular the standards of the UN, the World Bank and Eurostat, allows for a comparative analysis of demographic processes on a global scale.

In general, the methodological aspects of statistical research of demographic processes of the population are based on the integral combination of data quality, indicator system, analysis and forecasting methods. These methodological approaches are of significant scientific and practical importance in deeply understanding demographic processes, assessing their impact on socio-economic development, and formulating effective demographic policy.

The table below presents the number of births in the Republic of Uzbekistan as of January 2024 and 2025 by region. The table allows you to identify regional differences in demographic processes, conduct a comparative analysis of birth dynamics, and assess the statistical characteristics of the population renewal process. The indicators are expressed in absolute numbers, and the growth rates are expressed in percentages, which serve to reveal the differences in the demographic situation by region.

Table 1

Number of births¹

Regions	2024	2025	Compared to January 2024, %	Difference (+/-), person
Republic of Uzbekistan	71,930	75,603	105.1	+3 673
Republic of Karakalpakstan	3 479	3 485	100.2	+6
Provinces:				
Andijan	6 557	6 670	101.7	+113
Bukhara	3 431	3,606	105.1	+175
Jizzakh	3 157	3 172	100.5	+15
Kashkadarya	7,607	8,497	111.7	+890
Navoi	1,986	2 107	106.1	+121
Namangan	6 202	6 610	106.6	+408
Samarkand	8 468	9,023	106.6	+555
Surkhandarya	6 298	7 009	111.3	+711
Syrdarya	1,739	1,798	103.4	+59
Tashkent region	5,948	5,773	97.1	-175
Fergana	7,752	8 465	109.2	+713
Khorezm	3,589	3,816	106.3	+227
Tashkent city	5,717	5 572	97.5	-145

Statistical analysis of the table data shows that as of January 2025, the number of births in the republic amounted to 75,603 people, an increase of 5.1% compared to January 2024. This confirms that the process of population renewal in Uzbekistan continues steadily. In demographic statistics, such an increase is an important component of natural movement and is explained by positive trends in the age structure of the population and family behavior.

The analysis by region shows an uneven distribution of birth rates. In particular, a significant increase in birth rates was observed in the Kashkadarya (111.7%), Surkhandarya (111.3%) and Fergana (109.2%) regions. The high proportion of young people in these regions, traditional family values and a significant share of the rural population lead to a relatively high birth rate. From a statistical point of view, this situation indicates the need to separately assess birth rates by region.

At the same time, the decrease in the number of births in Tashkent region and Tashkent city (–175 and –145 people, respectively) is associated with urbanization, late marriage, increased female employment, and changes in reproductive behavior, which reflect demographic trends typical for developed regions. These differences scientifically justify the need to use territorial and structural analysis methods in the statistical study of demographic processes, not limited to average republican indicators. Table1

In general, the tabular data show the importance of analyzing fertility rates based on dynamic, regional, and comparative approaches in statistical research of population demographic processes. This serves as an important statistical basis for scientifically substantiating demographic policy, planning social infrastructure by region, and compiling long-term demographic forecasts.

One of the important aspects of statistical research of demographic processes is the determination of their correlation with socio-economic development. Changes in the number and structure of the population directly affect the formation of labor resources, the expansion of the consumer market, the

¹Monthly publication of the Statistical Agency under the President of the Republic of Uzbekistan. Socio-economic situation of the Republic of Uzbekistan January 2025. p. 9.

load on the education and health systems, as well as the development of territorial infrastructure. Therefore, modern demographic statistical research requires a comprehensive approach aimed at identifying their causes and consequences, not limited to calculating birth or death rates.

In recent years, the issue of territorial differences in the study of demographic processes has gained particular scientific importance. In the case of Uzbekistan, the intensity of birth and migration differs significantly across regions. This situation indicates the need to use territorial indicators in addition to average republican indicators when assessing demographic processes. In-depth analysis of such differences using groupings, indices, and variation indicators in statistical studies increases the accuracy of scientific conclusions.

In the statistical study of demographic processes, urbanization and migration factors are becoming increasingly important. The increase in internal migration flows is leading to an increase in population density in large cities and industrial centers, and a decrease in demographic pressure in some regions. These processes are causing uneven formation of birth rates across regions. Statistically, such situations are assessed through indicators such as the migration balance, the urban-rural population ratio, and the level of urbanization.

Also, in demographic studies, taking into account such factors as population quality indicators, life expectancy, maternal and child health, and education level is becoming an important methodological task. Modern statistical approaches allow us to assess demographic processes not only quantitatively, but also qualitatively. This enriches the concept of "demographic growth" with the concept of "demographic development".

The importance of forecasting methods in the in-depth study of demographic processes is also increasing. Forecasts based on the cohort-component method allow us to predict future changes in the population size and age structure. The results of statistical forecasts serve as an important scientific basis for the development of state social policy, employment programs, planning the network of educational institutions, and regional development strategies.

Modern approaches to statistical research of population demographic processes are based on a combination of multi-source information bases, territorial and structural analysis, forecasting and assessment of the impact of factors. These methodological approaches are important for a deep understanding of demographic processes, assessing their impact on socio-economic development, and formulating scientifically based demographic policies.

The results obtained and their discussion show that statistical research of demographic processes of the population is an important tool not only for describing the current situation, but also for scientifically substantiating future development directions. The experience of the world and Uzbekistan confirms that demographic processes are becoming increasingly complex, and in their assessment, along with classical indicators, modern statistical and forecasting methods need to be used.

In this context, the results of demographic statistical analysis serve as an important scientific and practical basis for formulating the state's socio-economic policy, developing regional development programs, and making decisions aimed at improving the well-being of the population.

4. Conclusion and suggestions

This study analyzed the theoretical and methodological aspects of statistical research of demographic processes of the population based on a comprehensive approach. The results of the study showed that demographic processes, births, deaths, migration and changes in the population structure have a direct and long-term impact on the socio-economic development of the country. Therefore, their accurate measurement, analysis and interpretation in statistical terms is an important condition for the formation of scientifically based demographic policy.

The study revealed that in recent years, Uzbekistan has been characterized by stable population growth, a high proportion of young people, and regional differences in fertility rates. Regional analyses have shown that fertility rates are not uniform, and that fertility rates are relatively low in regions with a high level of urbanization. This situation confirms the need to widely apply territorial and structural analysis methods in assessing demographic processes, not limited to average indicators.

It was also found that the quality of the information base and methodological coherence are of great importance in statistical research of demographic processes. Integration of official statistical data with sample observations and administrative registers serves to increase the accuracy and reliability of demographic indicators. The use of modern statistical and forecasting methods allows for a scientific assessment of the future development trends of demographic processes.

Based on the conclusions obtained, it is considered appropriate to put forward the following practical and scientific proposals:

1. In order to improve demographic statistics, it is necessary to develop a single integrated information system between population censuses, civil registry data, and administrative registers.
2. To better understand demographic processes across regions, it is necessary to expand the use of standardized indicators by age and gender.
3. It is recommended to actively implement statistical modeling and forecasting methods in assessing the demographic impact of urbanization and migration processes.
4. When formulating demographic policy, it is advisable to plan regional social infrastructure, education, and employment programs based on the results of statistical analysis.

In conclusion, a deep and systematic study of the methodological aspects of statistical research of population demographic processes is of significant scientific and practical importance in ensuring the long-term socio-economic development of the country, increasing the well-being of the population, and implementing effective demographic policy.

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