

**D. A. TSENOV ACADEMY OF ECONOMICS – SVISHTOV**  
**DEPARTMENT OF STATISTICS AND APPLIED MATHEMATICS**

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**STATISTICAL SURVEY OF DEMOGRAPHIC PROCESSES IN  
BULGARIA – REGIONAL ASPECTS**

**AUTHOR'S SUMMARY**

**Dissertation for the award of educational and scientific  
Degree "Doctor" in a scientific specialty  
"Statistics and demography"**

**Scientific supervisor:  
Assoc. Prof. Lyubomir Ivanov, PhD**

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The dissertation thesis consisted of 222 pages, of which 173 were main texts. Structurally, it included an Introduction, an Exposition in three chapters, a Conclusion, a List of used literature – 206 sources (173 in Cyrillic and 33 in Latin), 22 Appendixes, and a Declaration of Originality. 21 figures and 20 tables were included in the main text.

The scientific jury's final meeting for the dissertation defense will be held on 12.04.2024 at 11:00 am in the Rectorate Conference Hall of the D. A. Tsenov Academy – Svishtov.

The defense materials are available to those interested in the "Doctoral Studies and Academic Development" Office of the D. A. Tsenov Academy of Economics – Svishtov.

# **I. GENERAL CHARACTERISTICS OF THE DISSERTATION**

## **1. Topicality of the topic**

The changes in the demographic behavior of the population over the past three decades are significantly influenced by the degree of socio-economic development of the Republic of Bulgaria. The changes affect the country's population both as a whole and regionally – by municipalities, districts, and planning regions. The demographic processes that take place are divergent and of different intensities. This heterogeneity exacerbates inequalities and poses several problems related to the ability to manage these adverse processes.

The significant issues related to the study of the demographic processes in the country are related to revealing the possibilities through statistical methods to collect reliable and up-to-date information about their state and dynamics and on this basis to analyze the problems in regional imbalances, to establish the related regularities in the development of the main demographic processes characterizing the reproduction and migration of the population of the Republic of Bulgaria.

## **2. Object and subject of the study**

**The object** of study in the dissertation is the demographic processes in Bulgaria in a regional aspect for the period 2000-2021.

**The subject** of the study is the regional differences and regularities in the development of demographic processes in Bulgaria.

## **3. Purpose and tasks of the dissertation**

**The aim of the dissertation** is a theoretical, methodological, and empirical study of the state and development of demographic processes in Bulgaria for the period 2000-2021 at the national and regional level, establishment of regularities, and establishment of factor influences on demographic processes.

The realization of the set goal is carried out by solving the following research tasks:

**First**, to clarify the nature of demographic processes and to systematize the factors influencing them.

**Second**, to present the sources of information for statistical research on demographic processes.

**Third**, to track the condition, dynamics, and regional differences in fertility and mortality.

**Fourth**, to identify trends, regional features, and differences in migration processes.

**Fifth**, to reveal and model factor influences on fertility and mortality rates.

**Sixthly**, to develop short-term forecasts of major demographic processes using selected models that characterized the trend of development.

#### **4. Research thesis**

**The research thesis** of the dissertation states that there are differences between the regions in the country in terms of the state and dynamics of demographic processes, and these differences were deepened under the influence of demographic and socio-economic factors.

#### **5. Information base**

The main sources of information for empirical analysis of demographic processes – birth rate, mortality, and migration are the official publications of the National Statistical Institute (NSI) – "Statistical Yearbook", the website of the National Statistical Institute – [www.nsi.bg](http://www.nsi.bg) and Eurostat. The statistical data processing was carried out using MS Excel and statistical software – Gretl.

#### **6. Methodology of the study**

**The research methodology**, used in the dissertation to fulfill the set goal includes methods of analysis and synthesis, methods of econometric modeling, comparative method, inductive and deductive method, graphical method, statistical methods for characterizing regularities in the development of demographic processes, methods of regression analysis to reveal the links and dependencies between phenomena.

## **7. Restrictive conditions of the study**

In connection with the wide scope of the dissertation thesis, it is necessary to indicate restrictive conditions. The survey covers the demographic processes for the period from 2000 to 2021. The focus on this period is because since 2000 six planning regions have been established on the territory of the Republic of Bulgaria.

In the dissertation, there are no international comparisons of demographic processes, population surveys according to the level of education, ethnicity, population according to working age (in, above, and below working age), and others. Demographic processes are not represented by the diagram of Lexis, demographic processes – "marriage" and "divorce" – are not studied and analyzed. Analysis of the impact of COVID-19 on demographic processes has not been carried out, as within the period studied the pandemic was not over. Short-term forecasts have been made for some demographic processes for the period 2022-2025.

The author considers it appropriate to express his gratitude to his scientific supervisor for the support provided in writing the dissertation and to the academic staff of the Department of Statistics and Applied Mathematics at the D. A. Tsenov Academy of Economics – Svishtov for the useful opinions, consultations, and support in the preparation of the dissertation.

## **II. STRUCTURE AND CONTENT OF THE DISSERTATION**

The dissertation thesis consisted of 222 pages, of which 173 were main texts. Structurally, it included an Introduction, an Exposition in three chapters, a Conclusion, a List of used literature – 206 sources (173 in Cyrillic and 33 in Latin), 22 Appendixes, and a Declaration of Originality. 21 figures and 20 tables were included in the main text.

The structure of the dissertation is as follows:

### **INTRODUCTION**

#### **Chapter One. DEMOGRAPHIC PROCESSES IN BULGARIA – ESSENCE, FEATURES AND NECESSITY OF THEIR STUDY**

- 1.1. Demographic processes and indicators for their measurement
- 1.2. Demographic processes – the subject of modern statistical research
- 1.3. Factors influencing demographic processes
- 1.4. Methods and models for studying the dynamics of demographic processes

#### **Chapter Two. INFORMATION ASSURANCE OF THE STATISTICAL SURVEYS ON DEMOGRAPHIC PROCESSES IN BULGARIA**

- 2.1. Population Census – the main source of information on demographic processes
- 2.2. Current statistical reporting as a source of information on demographic processes in the country and regions
- 2.3. Peculiarities of the statistical study of demographic processes at the regional level

#### **Chapter Three. REGIONAL DIMENSIONS OF DEMOGRAPHIC PROCESSES IN BULGARIA**

- 3.1. State, dynamics and regional differences in the birth rate in Bulgaria
- 3.2. Analysis of the status, trends, and regional disparities in mortality
- 3.3. Migration processes – trends and regional features and differences
- 3.4. Factor influences on demographic processes at the national and regional level

### **CONCLUSION**

**Declaration of Originality**

**References**

**Appendixes**

### **III. BRIEF STATEMENT OF THE DISSERTATION**

#### **INTRODUCTION**

The scientific work is dedicated to the problems concerning the demographic processes of natural movement – birth and mortality, and mechanical movement – emigration and immigration. The study of the population, and more precisely of the ongoing demographic processes, is of particular importance, since in recent years there has been a tendency to reduce the birth rate, and increase mortality and migration. The low birth rate in statistical regions and for the country is assessed as a negative phenomenon, the increase in mortality and migration also have negative consequences on the number and condition of the population. This determines our interest in studying the problems related to demographic processes, as well as their differences in regional aspects. Demographic processes are of particular importance since they have an impact on the natural growth, decline, and aging of the population. The lack of employment, low incomes of the population, living standards, and lifestyle are factors that affect demographic processes. As a result of the limited employment of the young working population, the impact on the demographic processes of population migration is also determined. The study of the demographic processes in the country and the regional aspect is necessary to identify the differences, as in some areas there is depopulation. A large part of the population is directed to areas with a more developed economy and with a greater opportunity to find employment.

## **Chapter One. DEMOGRAPHIC PROCESSES IN BULGARIA – ESSENCE, FEATURES AND NECESSITY OF THEIR STUDY**

The presentation of the first chapter of the dissertation is devoted to the essence and peculiarities of demographic processes – birth rate, mortality, migration, and indicators for their measurement. A descriptive characterization of the sources of contemporary statistical studies of Bulgarian authors on demographic processes has been carried out. The factors influencing demographic processes are formulated. Methods and models for the study of demographic processes are presented.

**Paragraph 1.1** clarifies the nature and specifics of demographic processes – birth rate, mortality, and migration. The essence of the population, studied from different points of view, as an object of study in several aspects is defined. The category "population" is defined as a community of persons inhabiting and living in a certain territory for an extended period. It has been established that the number of the population changes continuously, under the influence of various demographic processes. This change is expressed as a change in the occurrence of demographic events at each birth, death, migration, etc.

Demographic statistics are used to examine population totalities and demographic events. **Demographic events** are considered births, deaths, marriages, divorces, migration, for which period populations are formed, and units referring to a period. "**Demographic process**" means the totality of successive demographic events or changes in demographic conditions.

The specifics and peculiarities of the concepts of "population movement" and "change" are clarified. When these concepts refer to changes over time – they are associated with events births, deaths, marriages, divorces, and spatial changes – they belong to a migration movement associated with the transfer of persons from one territory to another territory.

**The birth rate** is presented as a major part of the components of the natural movement of the population, which is associated with the emergence of new individuals. In demographic statistics, the subject of research is the number of births and events related to the population, such as stillbirths, abortions, marriages, divorces, and others.



To establish the trend in the development of the birth rate, the fertility rate, and the age fertility rate is used.

After birth, each individual, regardless of his life expectancy, completes his life process, in which the demographic process – "mortality" occurs. Mortality is another major demographic process that, together with the birth rate, determines the natural movement of the population, and on which natural growth depends.

To measure and characterize changes in mortality development, the following indicators are used: total death rate, group death rates, and age death rates.

The total mortality of the population is assigned **infant mortality**. Child mortality is associated with changes in the age structure of the population, demographic aging, and the impact on the level of overall mortality of the population and average life expectancy. The decline in infant mortality is essential both for the demographic situation in the country and for the socioeconomic situation. Its reduction leads to an increase in the life and labor potential of the nation.

Another demographic process that is part of the natural reproduction of the population is **marriage**. It is seen as a family model, legalizing the relationship between a man and a woman, and creating a prerequisite for the birth of a child. Except under the influence of natural movement, the population number in each settlement, municipality, district, and district is also formed under the influence of its **mechanical (migration) movement**. These two types of movements have a significant impact on the composition of the population.

By its nature, migration is represented as a territorial movement of the population. Migrations cover changes of permanent residence and daily relocations. Demographic statistics look at migrations in terms of changes in permanent residence. As a result, outflows and inflows and two types of migration areas are outlined – exit and entry areas. The distinction between migration into internal and external happens according to whether it crosses a state border or not. The positive and negative sides of external migration are pointed out, and the reasons and consequences of the immigration process for the country are clarified.

Paragraph **1.2** discusses scientific publications – monographs, studies, and articles of famous demographers, and statisticians who have carried out research,

analyses, and forecasts related to the population and demographic processes in the country. The feature includes publications by Bulgarian authors such as I. Stefanov, Z. Sugarev, E. Hristov, A. Atanasov, B. Rusev, T. Kaloyanov, V. Boshnakov, V. Zhekova, S. Zhekova, M. Sugareva, K. Lilova, L. Spasova, D. Sabotnova, E. Dimitrova, K. Naydenov, T. Traykov, N. Kukov, R. Rangelova, K. Slaveva and others.

The research conducted regarding the demographic processes in Bulgaria is a significant number. Demographic processes are considered in different aspects. The publications are systematically set out and presented in five directions: a generalized demographic picture; reproduction, reproductive behavior, and marriage; Aging; mortality; and migration processes.

In the monographic work of I. Stefanov, Z. Sugarev, N. Naumov, and others (**Stefanov et al.**, 1974), a follow-up of changes in the number and structures of the population was carried out. A predictive analysis of demographic processes was made. The book of M. Sugareva, N. Tsekov, and others was attributed to the contemporary problem of depopulation in the Northwestern region of the Republic of Bulgaria (**Sugareva et al.**, 2008). A comparative analysis of the age structure by gender between Bulgaria and the Northwest region is made. The migration movement of the population in the districts of the region was traced. V. Zhekova in her monograph (**Zhekova**, 2002) examined the trends in social norms and traditions in the reproductive behavior of the population in Bulgaria. An analysis of the demographic decline in the country has been carried out, affecting marriage, birth rate, mortality, and emigration.

The trends were established in the work of **Balev et al.** (2005) about the demographic development of the country at the end of the 20th century and the beginning of the 21st century. The state and trends of demographic processes – birth rate, mortality, and migration, determining the development of the population and its demographic structure – were analyzed. The monograph of Atanasov, Toneva, and Gavazki (2011) established the dynamics of demographic processes – birth rate, mortality, migration, and natural and net migration growth. Comparisons were made between Bulgaria and selected European countries of the indicators characterizing the demographic processes and the forecast of the demographic profile of Bulgaria until 2060. In her monograph "Changes in the birth rate in Bulgaria – behavioral and value

dimensions" E. Dimitrova focused on the changes occurring in the birth rate (**Dimitrova**, 2011). The dynamics of the main fertility indicators such as the total fertility rate, the average age at birth of the first child, etc. were analyzed. The factors influencing the birth rate were indicated.

Studies on the mortality of women, the population, and gender in the Republic of Bulgaria were carried out by N. Golemanov (1998; 2001; 2004). Emphasis was placed on the causes of death applicable to all age groups. With the onset of the demographic process of "mortality", the population decreased. N. Kukov in his publication conducted a comparative analysis of the demographic processes of birth and mortality in the country and the world by describing the demographic situation (**Kukov**, 2021). He examined and analyzed the birth rate, as well as the degree of population aging, characterizes factors influencing mortality. The study "Statistical Dimensions of Regional Differences and Inequalities between Northern and Southern Bulgaria" (Slaveva et al., 2021) explored the differences between Northern and Southern Bulgaria in demographic, economic, and social aspects.

K. Haralampiev, in the publications "Impact of Internal Migration on the Number of Urban and Rural Population in the Republic of Bulgaria during the period 1996-1998" (**Haralampiev**, 2002) and „Migration Impact on the All Characteristics in the Life Tables" (**Haralampiev**, 2008), examined the impact of internal migration of the population by place of residence. He found that up to the age of 35, the movement is from the villages to the cities, after the age of 35 the movement is from the cities to the villages (this movement is mostly due to unemployment), and after the age of 65 such movement is not observed. V. Boshnakov (**Boshnakov**, 2021; 2022) explored the relationship between the socio-economic profile of emigrants and the achievement of migration goals, the typology of external migration of the potential for migration after 2007.

**Paragraph 1.3** clarifies and systematizes the factors influencing demographic processes. Their impact on fertility and mortality is indicated, and the following groups are distinguished: demographic factors, socio-economic factors, and psychological factors.

**Demographic factors** influencing the birth rate include marriage, divorce, birth contingent, and fertility. Demographic factors contribute to the decline in fertility and affect the number of women of fertile age, declining fertility of women of fertile age, birth contingent, marriage, divorceability, etc. Socio-economic factors, changes in understanding of the family, the desired number of children, and others are important for the onset of low birth rates.

An important factor is demographic aging, which is a prerequisite for increasing mortality. This factor has an impact on the birth rate in the direction of decreasing and emigration, which mainly has a migration movement of young people.

To the **socioeconomic factors** affecting the birth rate, we refer to the uncertainty in the professional realization of the population and income, the increase in the costs of childbirth and raising children, high unemployment and migration in the young population, educational, cultural, and living standards, etc. This group of factors influencing mortality includes the health status of the population, access to health services, working conditions, income of the population opportunities for treatments, etc.

To **psychological factors**, we relate attitudes and intentions, reproductive ideals, value orientations, etc. The change in the value system of the population, expressed in the pursuit of independent realization and material and household insurance, leads to postponement in time and leaves in the background the birth and upbringing of children. The relocation of the population temporarily or permanently outside the country or between different regions within Bulgaria is represented by migration processes. This migration movement is characteristic of persons of working and reproductive age. It is observed that a significant part of the population is concentrated in certain areas of the country, as a result of which smaller settlements are depopulated.

**The factors that predetermine internal migration** depend on the degree of economic development of the country, regions, and settlements. The factors having an impact on migration processes are grouped into the following two groups: factors stimulating the migration process and factors limiting the migration process.

To the first group of factors, we refer to *socio-economic and psychological factors*. Socio-economic factors are related to the aspiration of the person for full performance, professional realization, and career, obtaining good remuneration for

labor, etc. Another economic factor is the unemployment rate, which has an impact on migration processes. A stimulating factor of external migration is the low standard of living of the population.

*Psychological factors* are related to the determination of changes in the value system having a substantial influence on migration. As a motive for emigration, we believe that successful professional realization dominates.

The second group of factors includes *political-economic and psychological factors*. Political and economic factors are associated with the construction of a stable political system and a democratic form of development of the country. The stable political environment in Bulgaria acts as a refraining factor for the emigration processes and limits external migration. Psychological factors are related to the attachment of Bulgarians to the family, family lifestyle and culture, and the surrounding social environment. Some of these psychological factors cause the emigration of entire families or the subsequent emigration of the rest of the family.

The social policy of the state should include measures to limit the migration of the working-age population. It is necessary to provide funds for increasing employment, the preparation and qualification of the workforce, the creation of new jobs, etc., to create conditions for a better way of life.

The flow of emigration prevails mostly in the population of active age with a high level of education and qualification. This kind of emigration is to the benefit of the host countries. This harms Bulgaria as it reduces the labor resources in the country.

**In paragraph 1.4** the methods and models for studying the dynamics of demographic processes are described. Changes occurring over time in a given phenomenon or process are reflected by time series. When time series are built based on demographic indicators, they characterize the development of demographic processes.

Regularities in the dynamics of demographic processes can be described using generalizing measures of development. The descriptive indicators are presented by a form apparatus on a constant and chain basis (level of development, rate of development, absolute growth, growth rate, average size of the indicator, average absolute growth, average rate of development, average growth rate, and overtaking rate). The coefficient of preemption is presented by comparing the regularities of two interrelated phenomena.

The positive and negative sides of the descriptive indicators are indicated. The positive sides refer to the easy and fast conduct of computational operations, the results obtained are easy to perceive and interpret. The negative sides become uncertainty of the results of the obtained estimates due to the presence of extreme values; it is difficult to provide a precise analysis of the statistical significance of the results obtained; There are fewer opportunities to describe in detail the regularities of development.

The requirements for constructing the time series are presented. The analysis of the changes in the demographic processes in Bulgaria is based on time series. To ensure the objective accuracy of the data, it is necessary to comply with the following conditions: comparability in time, place, the scope of the population, content, and method of calculation of statistical quantities, structure, commensurability, and in terms of prices.

It is of particular importance, in our opinion, to consider the peculiarities of demographic processes, since changes in different territorial units lead to a violation of the requirement of comparability on the ground, and at the same time the continuous changes in the structure of the population by gender, age, education, etc. violate the requirement of comparability by structure.

Time series components containing trend or trend ( $\hat{Y}_t$ ), cyclical fluctuations ( $C_t$ ), seasonal fluctuations ( $S_t$ ), random fluctuations ( $\varepsilon_t$ ) Phenomena and processes developed under the influence of co-acting factors, namely systematic, random, seasonal, and cyclical. The following two relationships are classified - according to the shape of the relationship between the components: additive and multiplicative. The additive relationship is represented as a set of four main components, and the multiplicative relationship is the product of the components of development.

A characteristic is made of the trend models suitable for use in the analysis of demographic processes – the models of a straight line, a parabola, a polynomial of a higher degree, and an exponential function.

Establishing and modeling the trend of development is relevant in the analysis of time series of demographic indicators. The trend shows the direction of demographic development in terms of population size, population structure, birth rate, mortality, and migration. Through the statistical toolkit for testing hypotheses, the trend of

development, the strength, and the direction of change are established. The rank correlation coefficients of Spearman and Kendall are used, as the first-order autocorrelation coefficient and its corresponding Box-Ljung and Box-Pierce test characteristics. The presence of autocorrelation is affected by utilizing the Durbin-Watson coefficient. The estimation of the parameters of the regression models is performed with the least squares method.

## **Chapter Two. INFORMATION ASSURANCE OF THE STATISTICAL SURVEYS ON DEMOGRAPHIC PROCESSES IN BULGARIA**

The presentation of the second chapter of the dissertation describes the censuses conducted in the Republic of Bulgaria, the current demographic statistics, the administrative-territorial structure of the country traced, as well as the changes, the NUTS classification of Eurostat is clarified. At the same time, the criteria of the hierarchical levels of territorial units are indicated.

**Paragraph 2.1** presents population censuses as a source of information on demographic processes.

Interest in the number and composition of the population arose from the time of the first organized human societies. Since ancient times, population censuses have been carried out, serving to meet the information needs of the state. The modern census is a significant statistical event that is carried out based on a previously developed detailed plan and program. They set out the procedures for the organization and conduct of the census itself. The information obtained from the census allows us to analyze and forecast the main demographic processes – birth rate, mortality, reproduction, marriage, divorce, and natural and net migration growth.

The purpose of the census is to obtain information on the number, territorial distribution, and composition of the population by gender, age, marital status, ethnicity, education, occupation, place of work, social belonging, etc. Through a population census, reliable, comprehensive, and detailed information on the population is provided – for the whole country and by individual administrative-territorial units. It provides the necessary conditions for comparability and comparability of country statistics with those of partners in international organizations.

The basic principles of UN statistics in the Code of European Census Statistics are outlined, which in turn are: individual census, simultaneity, periodicity, decorativeness, and confidentiality.

Population presents itself as a dynamic statistical population that is characterized by continuous changes in its number and structure. A population census serves to establish the number and structures of the population at a given point of observation.

The main features and characteristic features of the censuses are described, as well as the signs covered by the census program. The ways of registering the primary population data are presented in detail – by questioning the census persons by the enumerators and by self-monitoring by filling in the census cards by the respondents.

A distinguishing characteristic is made of the range of the following categories of population as an object of observation – available, permanent, and legal. It is clarified that the total of the permanent and available population, as well as the temporarily absent and temporarily present persons, provide complete information about the scope of the population data, the country by regions, districts, and municipalities.

There is a substantial difficulty in accounting for the available population due to its mobility. It can be mentioned that an important point in the observation is the distinction of persons of arrivals and departures.

In the census of population **unit of observation** appears the individual, the family, or the household. Man (individual, individual) presents himself as the simplest and most ordinary unit of observation. In addition to the aggregate of persons, the aggregates of families and households are formed. The household is the standard international unit of observation in the census.

For each census, the National Assembly shall adopt an administrative act (Act) specifying the tasks and obligations of the census bodies – National Statistical Institute, Central Census Commission, Regional Census Commissions, Regional Statistical Bureaus, Municipal Census Commissions, Controllers, and Tellers. The activity, organization, and preparation for the population census are described. The responsibilities and duties of controllers and tellers are presented.

It is characteristic that each population census is preceded by conducting a sample population census and testing the overall tools and organization of the census. This



provides an opportunity to reduce errors and improve the organization and methodology of the census.

Population information for the last four censuses conducted after 1989 – the first at the end of the 20th century in 1992, and the next three in the first quarter of the 21st century, in 2001, 2011, and 2021 are presented. In addition to population censuses, data are also obtained from current demographic statistics.

The Population and Housing Census Act in the Republic of Bulgaria regulates the preparation and organization of the population and housing census. The purpose of the census is to collect reliable, detailed, comprehensive, and comparable data on the population and housing stock of the country.

**Paragraph 2.2** describes current statistical reporting as a source of information on demographic processes in the country and regions.

Current demographic statistics serve to reflect the changes in the number of the population by providing information on the natural and mechanical movement of the population for a certain calendar period. Each demographic event is characterized by the number, date, and place of its occurrence, as well as the following socio-demographic characteristics of the persons – gender, age, marital status, education, place of residence, etc.

With the help of data from the current demographic statistics, current calculations of the population at the end of each calendar year are carried out. Population data obtained from current demographic statistics and censuses are used to analyze the ongoing demographic processes by the general government. The average annual population by year has an important cognitive significance, it is also calculated and published.

The main source of information for obtaining data from current demographic statistics through the templates is presented **ESGRAON**<sup>1</sup> – **TDS**. They serve to register demographic events by settlements, municipalities, districts, and in general for the country. The reporting of demographic events – the natural and mechanical movement

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<sup>1</sup> ESGRAON – The Unified System for Civil Registration and Administrative Services of the Population is a national system for civil registration of individuals and contains personal data about the population in the Republic of Bulgaria..

of the population, is carried out by the administrative units responsible for this and then the data are presented to the statistical authorities.

Through the current demographic statistics, data are provided on the number of children born, the number of deceased persons, the number of marriages, the number of divorces, and the number of emigrated and immigrated persons, based on which the population at the end of each calendar year is calculated. From the current demographic statistics is established information about the natural and mechanical movement of the population by territorial units, according to the classification **NUTS** (*Nomenclature of territorial units for statistics* – Nomenclature of territorial units for statistics) and at the national level.

The functionality and scope of the USCRASP system are described. The same is built and operates on three levels – national, regional, and municipal. USCRASP is a basic information system that provides data to other information systems in the country, but at the same time receives data from them. The instructions for USCRASP are received from the Civil Registration Act and Ordinance No RD-02-20-09 on the functioning of the Unified Civil Registration System. The functioning of the USCRASP system allows for the daily provision of up-to-date information to other ministries, departments, courts, etc. Institutions.

The methods, terms, forms, and conditions for issuing the Birth, Marriage, and Death Certificates as official written documents are described. The officials shall register in them the occurred event – birth, marriage, death, according to an established procedure in the Civil Registration Act. The duties of the persons occupying the position of experts at the municipal level are related to the generalization of the information on the documents on paper and in electronic format through a software product, after which they transmit them to the Territorial Unit "GRAO" in the field, and they, in turn, provide the information to the NSI.

Current demographic statistics have to reflect the changes in the number of the population and provide data on demographic processes at a certain time. Population data from current demographic statistics provide an opportunity to generalize about the number and structure of the population, and demographic events, identify ongoing demographic processes, and carry out analyses and forecasts.

**Paragraph 2.3** describes the peculiarities of the statistical study of demographic processes at the regional level.

The characterization of the demographic and socio-economic processes in the country by regions, districts, and municipalities is based on up-to-date, reliable, and comparable statistical data. Distinguishing the state and development of the regions and districts in the country, revealing the trends in the socio-economic life, and the accession of Bulgaria to the European Union requires the establishment and maintenance of an adequate information base.

Eurostat shall establish a Nomenclature of Territorial Units (**NUTS**) that meets the requirements of the standards for the European Community, which applies to the collection, exchange, and publication of statistics. It has been developed for statistical purposes and acts as a separate, interconnected system of territorial division of the European Union.

The administrative-territorial structure of Bulgaria from 1878 until now is presented, which over the years has undergone development and several changes. Through the administrative-territorial structure of Bulgaria, information is obtained about the division of the country into districts (counties, districts) and municipalities. With the reform in 1934, 7 districts were established in the country, which is similar in many characteristics to the districts that existed in the period 1987-1999. These are the regional centers of Vratsa, Pleven, Shumen, Sofia, Plovdiv, Stara Zagora and Burgas.

After 1989, changes in the administrative and territorial structure were made in the country. In 1995 the Law on the Administrative-Territorial Structure of the Republic of Bulgaria was adopted, which serves to settle and create administrative-territorial and territorial units in the Republic of Bulgaria and to carry out administrative-territorial changes<sup>2</sup>. In 1999, a change was made, as a result of which the number of districts in the country became 28 and the municipalities were 262.

In 2008, a Regional Development Act was adopted, it is consistent with the provisions of European law for Bulgaria as a Member State of the European Union.

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<sup>2</sup> According to the Act, administrative-territorial units are districts and municipalities, constituent administrative-territorial units in municipalities are mayoralties and districts, and territorial units are settlements and settlement formations. Settlements are divided into towns and villages, and the existing settlements such as hamlets, huts, railway stations, mining and industrial settlements acquire the status of villages.

Areas are differentiated for planning purposes, which are divided into three levels, according to the requirements of the common classification of territorial units for statistics applied in the European Union.

The territorial scope of the regions for Bulgaria has been changed following Regulation (EC) No 176/2008 amending Regulation (EC) No 1059/2003 on the establishment of a common classification of territorial units of Bulgaria in connection with its EU membership. Three hierarchical levels of territorial units that correspond to NUTS1 have been defined. Thus, each country is divided into a certain number of zones subdivided into NUTS2-level areas, and these in turn are subdivided into NUTS3-level areas. These three levels serve to collect, process, and disseminate regional statistical information by the National Statistical Institute and by Eurostat.

In December 2007, a change was made within the borders of the regions of Bulgaria. This change is based on Eurostat requirements for territorial units within the European Union, with residents living in each region in the range of 800,000 to 3,000,000 inhabitants. For this reason, changes have been made to the territorial scope of the regions of the country.

The changes in the territorial coverage of the regions of levels 1 and 2, according to the NUTS classification used by Eurostat, are reflected in the presentation of the data by statistical regions of the main demographic, social, and economic indicators from 2008. Differences in the coverage of areas before and after 2008 make it difficult to compare their indicators over a longer period, as they violate the requirements for comparability and comparability of statistics by territorial scope. This difficulty is overcome because for previous years NSI provided data both by statistical regions and by districts, which makes possible the subsequent recalculation and adaptation to the current NUTS2 classification. One of the main tasks of the new zoning is related to overcoming the differences in regions.

The statistical zones correspond to the NUTS1 level of the Eurostat NUTS classification and are formed by the 6 statistical regions corresponding to the NUTS2 level. The statistical regions are formed by the 28 districts which correspond to the NUTS3 level (Table 1).

**Table 1.** Planning regions in the Republic of Bulgaria in 2000 and 2008

Statistical zones NUTS1	Statistical regions NUTS2	Statistical regions NUTS3 – administrative districts	
		2000	2008
North and Southeast Bulgaria	North-West Region	Vidin, Vratsa, and Montana	Vidin, Vratsa, Montana, Lovech and Pleven
	North Central Region	Ruse, Veliko Tarnovo, Gabrovo, Pleven and Lovech	Ruse, Veliko Tarnovo, Gabrovo, Razgrad and Silistra
	North-East Region	Varna, Targovishte, Shumen, Razgrad, Silistra and Dobrich	Varna, Targovishte, Shumen and Dobrich
	South-East Region	Burgas, Sliven and Yambol	Burgas, Sliven, Yambol and Stara Zagora
Southwest and South Central Bulgaria	South Central Region	Plovdiv, Kardzhali, Haskovo, Pazardzhik, Smolyan and Stara Zagora	Plovdiv, Kardzhali, Haskovo Pazardzhik and Smolyan
	South–West Region	Sofia – capital, Sofia region, Kyustendil, Blagoevgrad and Pernik	Sofia, Sofia-capital, Kyustendil, Blagoevgrad and Pernik

Source: Angelova (2013, p. 107).

The range of regions in Bulgaria is presented, indicating the number of municipalities, cities, villages, area occupied, population density, and degree of urbanization.

The change made concerning the NUTS classification for territorial units is related to the range of regions. It was carried out to eliminate intraregional and interregional disparities, with limited lagging areas and including one or more municipalities.

### **Chapter Three. REGIONAL DIMENSIONS OF DEMOGRAPHIC PROCESSES IN BULGARIA**

The third chapter of the dissertation paper contains a study of the dynamics, and regional differences of demographic processes in Bulgaria – fertility, mortality, and

migration for the period 2000 – 2021, projected dimensions for the period 2022 – 2025, modeling and measurement of factor influences.

**Paragraph 3.1** identifies and presents the status, dynamics, and regional differences in the birth rate in Bulgaria.

The dynamics of the birth rate in Bulgaria after 2000 is traced, which found that after the beginning of the changes in 1990, there was a serious decline in the number of live births. In 1990, 105 180 children were born, by 1995 their number had decreased to a level of 64 125, then slightly increased and in 2000 reached a level of 73 679. The crisis that occurred after 2008 negatively affected the demographic process, which has seen a decline in the birth rate, which continues until the end of the research period. The factors that lead to a decrease in the number of children born in Bulgaria are caused by the change in the age structure of the population, a decrease in the share of the young population, the migration movement, the reduced number of women of fertile age, and their reduced fertility.

The gross fertility rate is a major indicator that characterizes the birth rate. It examines the birth rate at the national and regional levels. The data show that for the period 2000-2009, there is a tendency to increase the birth rate, which reaches 10.7‰. The coefficient started to decrease after 2010, falling to 8.5‰ in 2021.

It was found that the regional trends in the dynamics of the fertility rate follow the general trend for the country – an increase until 2009, followed by a decrease for the period 2010 – 2021. The highest birth rate is in the Southeastern and Northeast regions. The lowest birth rate is in the Northwest and North Central regions.

The other indicator with the help of which the trend in the change in the birth rate can be established is the total fertility rate. It is found that its lowest values prevailed at the beginning of the period – in 2002, with the average number of children per woman being 1.21. The ratio increased until 2009, when it reached a level of 1.57 children, after which it stabilized and varied slightly between 1.50 and 1.58 children.

Differences at the regional level on the indicator total fertility rate are established through the rank of the scatter. These differences throughout the period analyzed are significant between the South-East and the North Central regions.

An important aspect of fertility research related to the analysis of the reproductive behavior of the population is the dynamics of the average age at the birth of the first child and the birth of a child. Globally, there is a tendency to increase the average age at the birth of a first child. As early as the early 1990s, the postponement of the first births began in Bulgaria, which was expressed in an increase in the average age of birth of the first child. During the study period, the average age for the birth of a first child increased by four years – from 23.5 years in 2000 to 27.5 years in 2021.

The average age at the birth of a first child for the period 2000-2021 is the lowest in the Northwestern region – 24.4 years, and the highest in the Southwestern region – 27.5 years, while the national average is 25.9 years. From the calculated average rates with a chain base, it can be seen that the average age at the birth of a first child is growing, with the growth for the Southwest and Northeast regions being the fastest - 0.8% on average per year.

Apart from a change in the mean age at birth of a first child, there is also a change in the mean age at birth of a child. For Bulgaria, the average age at birth of a child was 24.9 years in 2000 and increased to 29.0 years in 2021. The lowest average age for childbirth at the beginning of the period is the Southeastern and Southern Central regions, respectively with 24.3 and 24.5 years in 2000.

The results of the conducted analysis and the calculated descriptive characteristics of the time series are grounds for the formation of hypotheses for the presence of a trend in their change. The check for the presence of a trend in the time series containing data on fertility rates was performed by the Spearman and Kendall correlation coefficients and the first-order autocorrelation coefficient (Table 2).

**Table 2.** Check for the presence of a trend in the time series of the fertility rate by regions and total for the country (2000-2021)

Indicator	SZR	SCR	SIR	UIR	UZR	UCR	Total for the country
Coefficient of Spearman ( $\rho_{em}$ )	-0.439	-0.272	<b>-0.604</b>	-0.164	0.303	-0.147	-0.097
Test characteristic ( $z_\rho$ )	-2.01	-1.24	<b>-2.77</b>	-0.75	1.39	-0.68	-0.44
Coefficient of Kendall ( $\tau_{em}$ )	-0.307	-0.195	<b>-0.463</b>	-0.195	0.134	-0.143	-0.160
Test characteristic ( $z_\tau$ )	-2.00	-1.27	<b>-3.02</b>	-1.27	0.87	-0.93	-1.04

Coefficient of Autocorrelation ( $r_1$ )	<b>0.655</b>	<b>0.881</b>	<b>0.905</b>	<b>0.830</b>	<b>0.866</b>	<b>0.843</b>	<b>0.867</b>
Test characteristic ( $BL$ )	<b>10.79</b>	<b>19.54</b>	<b>20.59</b>	<b>17.32</b>	<b>18.86</b>	<b>17.86</b>	<b>18.90</b>
Test characteristic ( $BP$ )	<b>9.44</b>	<b>17.09</b>	<b>18.02</b>	<b>15.16</b>	<b>16.50</b>	<b>15.63</b>	<b>16.54</b>

Source: Author's calculations.

The theoretical limit of the test characteristics for the Spearman and Kendall coefficients was determined using the table of the t-distribution and was **2.080** at a 5% risk of error. The theoretical limit of the Box-Pierce and Box-Ljung test characteristics is taken from the table of  $\chi^2$ - distribution and has a value of **3.84** at a 5% risk of error.

Comparing the empirical and theoretical meanings of the test features shows that the Spearman and Kendall coefficients found a statistically significant trend only in the Northeast region. According to the first-order autocorrelation coefficient, for all time series of fertility coefficients the hypothesis of no trend has to be rejected, i.e. – the presence of a trend is established. The difference between the individual criteria, in our opinion, is explained by the type of trend, which is characterized by a change from increase to decrease.

Modeling of the trend of development in the studied time series of the fertility rate in a regional aspect was carried out utilizing the method of least squares. The following forms of functional dependence with time have been selected: a polynomial of the first degree (straight line), a polynomial of the second degree (parabola), a polynomial of the third degree (cubic parabola), a hyperbola, and a semi-logarithmic function. The choice of the most suitable model is based on the criteria standard error of the model, coefficient of definition, and  $F$ -distribution of Fischer. The presence of autocorrelation in the residual elements around the trend lines does not cause problems in the particular case, since the distribution of the parameter estimates of the regression function was found to be asymptotically normal, and all statistical tests followed the usual distributions asymptotically.

The birth rate for the country is expected to reach 6.92‰, with the lowest forecast for the North Central region – 5.77‰, and the highest birth rate in the Southwestern region – 7.68‰.

In **paragraph 3.2** the situation was analyzed, and trends and regional differences in mortality were identified.



Mortality is a major demographic process, the intensity of which affects the number and structure of the population. The demographic process "mortality" is analyzed by statistical series that contain data on the number of deaths, the mortality rate, and the infant mortality rate. The overall mortality rate is influenced by the aging process. It is due to the entry of small generations into the population, which is a consequence of declining birth rates, increased external migration, and changes in age-related mortality.

The dynamics of the number of deaths in Bulgaria for the period 2000 – 2021 is traced. At the beginning of the period (2000), their number was 115 087 people. Over the next 20 years (2000-2019), the number of deaths varied slightly, in 2019 it decreased to 108,083. With the beginning of the COVID-19 pandemic, significant changes are taking place in Bulgaria, resulting in a sharp increase in the number of deceased persons – in 2020, 124,735 people died or 16,652 more people than in 2019, and 2021 it reached an extremely high peak of 148,995 people – 24,260 people more than the previous 2020 and 40,912 more people than before the pandemic in 2019. We can assume that as the main waves of the pandemic pass, the number of deaths will fall just as sharply and return to its downward trend.

The main indicator that characterizes mortality is the mortality rate, and for the same, an analysis was carried out for the period 2000-2021. There is a slow and gradual increase for the period 2000 – 2019, followed by a sharp increase in 2020 and 2021. In 2000, the mortality rate was at 14.1‰, and in 2019 it reached 15.5‰ – there was an increase of 1.4 percentage points. The magnitude of the overall mortality rate is influenced by the deteriorating age structure of the population and the degree of population aging.

The mortality rate by statistical regions shows certain differences. The North-East, South-East, South Central, and South-West regions have similar indicators within relatively narrow limits, and the North-Central and especially the North-West regions are distinguished by higher values in the mortality rate. The Northwest region remains the region with the highest mortality rate throughout the study period 2000 – 2021, with an important 17.9‰ in 2000, which increased to 20.5‰ in 2019 (before Covid-19) and reached 28.4‰ during the peak of the pandemic in 2021. In the North Central Region,

the mortality rate in 2000 was 15.4‰ – second in the country, increased to 17.6‰ in 2019, and in 2021 it reached 25.3‰.

For more detailed research and analysis of the ongoing demographic processes, mortality rates in the country and the different statistical regions are presented by gender. Mortality rates for the country are higher for men than for women and this is maintained for the entire study period 2000 – 2021. At the beginning of the period (2000), the mortality rate for men was 2.7 percentage points higher, but by 2019 the gap gradually decreased and reached 2.1 percentage points before the pandemic. Since the start of the pandemic, the mortality gap between men and women has risen sharply to 3.2 percentage points.

Another important indicator that is used for mortality analysis is the infant mortality rate. This indicator serves to measure the mortality of newborns and young children up to the age of 1 year. It is characterized by the fact that it is not influenced by the age structure of the population and reflects the care taken by parents, the state, and society to protect the health and life of newborn children.

It is found that infant mortality decreases even before the beginning of the research period. This downward trend continues throughout the period 2000-2021, reaching a level of 5.6‰ in 2021 from a value of 13.3‰.

From the calculated average annual rates on a chain basis, the decrease in infant mortality rates by region and total for the country is also confirmed, which is most pronounced in the South-Central region, where a value of 4.9‰ is reached.

**Table 3.** Check for the presence of a trend in the time series of the mortality rate by regions and total for the country (2000-2021)

Indicator	SZR	SCR	SIR	UIR	UZR	UCR	Total for the country
Coefficient of Spearman ( $\rho_{em}$ )	0,914	0,906	0,890	0,947	0,549	0,954	0,895
Test characteristic ( $z_\rho$ )	4,19	4,15	4,08	4,34	2,52	4,37	4,10
Coefficient of Kendall ( $\tau_{em}$ )	0,766	0,758	0,732	0,827	0,446	0,844	0,758
Test characteristic ( $z_\tau$ )	4,99	4,93	4,77	5,39	2,90	5,50	4,93
Coefficient of Autocorrelation ( $r_1$ )	0,889	0,921	0,902	0,909	0,912	0,921	0,917
Test characteristic ( $BL$ )	17,38	18,68	17,92	18,19	18,29	18,66	18,51

Test characteristic ( <i>BP</i> )	<b>19,87</b>	<b>21,34</b>	<b>20,48</b>	<b>20,79</b>	<b>20,90</b>	<b>21,32</b>	<b>21,15</b>
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Source: Author's calculations.

The empirical meanings of the criteria used to check for the presence of a trend in the analyzed time series are presented in Table 3. The empirical test characteristics of the Spearman and Kendall correlation coefficients calculated for the mortality rate for the country and all areas are larger than the theoretical (**2.080** at 5% risk of error), from which it follows that the rows contain a trend. The Box-Pierce and Box-Ljung test characteristics also exceeded the theoretical limit (**3.84** at 5% risk of error) for all rows of mortality rates. The tests give an agreed conclusion that the rows contain a clear and statistically significant trend of development. The positive values of the rank correlation coefficients of Spearman and Kendall are an indication of a tendency to increase.

**Table 4.** Check for the existence of a trend in the time series of infant mortality rates by regions and total for the country (2000-2021)

Indicator	SZR	SCR	SIR	UIR	UZR	UCR	Total for the country
Coefficient of Spearman ( $\rho_{em}$ )	<b>-0.929</b>	<b>-0.897</b>	<b>-0.947</b>	<b>-0.890</b>	<b>-0.951</b>	<b>-0.981</b>	<b>-0.986</b>
Test characteristic ( $z_\rho$ )	<b>-4.26</b>	<b>-4.11</b>	<b>-4.34</b>	<b>-4.08</b>	<b>-4.36</b>	<b>-4.49</b>	<b>-4.52</b>
Coefficient of Kendall ( $\tau_{em}$ )	<b>-0.775</b>	<b>-0.732</b>	<b>-0.835</b>	<b>-0.706</b>	<b>-0.827</b>	<b>-0.913</b>	<b>-0.931</b>
Test characteristic ( $z_\tau$ )	<b>-5.05</b>	<b>-4.77</b>	<b>-5.44</b>	<b>-4.60</b>	<b>-5.39</b>	<b>-5.95</b>	<b>-6.06</b>
Coefficient of Autocorrelation ( $r_1$ )	<b>0.814</b>	<b>0.899</b>	<b>0.860</b>	<b>0.808</b>	<b>0.896</b>	<b>0.914</b>	<b>0.975</b>
Test characteristic ( <i>BL</i> )	<b>14.59</b>	<b>17.77</b>	<b>16.29</b>	<b>14.37</b>	<b>17.65</b>	<b>18.36</b>	<b>20.90</b>
Test characteristic ( <i>BP</i> )	<b>16.68</b>	<b>20.31</b>	<b>18.61</b>	<b>16.42</b>	<b>20.17</b>	<b>20.99</b>	<b>23.88</b>

Source: Author's calculations.

For the infant mortality rate (Table 4), an analogous picture is established – all empirical characteristics, both of the Spearman and Kendall coefficients and the first-order autocorrelation coefficient, exceed the theoretical limits at a 5% risk of error. The hypothesis of the presence of a trend is accepted. The negative meanings of rank correlation coefficients indicate that the trend direction is towards a decrease.

**Table 5.** Average outranking rate between the time series of the fertility rate and the death rate by region and total for the country (2000-2021)

Areas	SZR	SCR	SIR	UIR	UZR	UCR	Total for the country
For the entire period 2000-2021.	0.974	0.972	0.970	0.977	0.984	0.973	0.977
For the period 2000-2019 (to Covid-19)	0.989	0.989	0.988	0.993	<b>1.001</b>	0.990	0.994

Source: Author's calculations.

The dynamics of the overtaking coefficients allow to establish regularities in the development of related indicators. In this study, a comparison between the dynamics of fertility rates and death rates is carried out. The average outranking rates obtained by comparing the rates of development of the fertility rate against the rates of the death rate in total for the country and by statistical regions are presented in Table 5.

Throughout the study period 2000 – 2021 for all regions and the total for the country, the overtaking ratios are below 1. They are characterized not only by higher death rates than birth rates, but also by dynamics in which death rates are growing faster than birth rates, and this means an increase in negative natural growth and a deepening of the unfavorable demographic situation.

If you look at the period 2000 – 2019 (up to COVID-19), the picture is preserved for the country and all areas except the Southwest. For this region, the overtaking ratio exceeds 1. This means that before the onset of the pandemic, in the Southwest region, the demographic situation differed from that of other regions – the birth rate was developing faster than the death rate, which in turn increased the natural growth in the region.

To establish the trend of development in mortality and infant mortality by region, time series modeling was carried out using the method of least squares. The choice of the most suitable model is based on a standard error of the model, the adequacy test, the coefficient of determination, and the information criteria of Akaike and Schwarz. As a change induced by the global COVID-19 pandemic has been noticed in the dynamics of mortality rates in the last two years of the period, additional dummy variables have been introduced into the models for these two years. ( $g_{2020}$  sub-2021

The construction of forecasts assumes that the effects of the global pandemic will subside and the dynamics of mortality will return to their trend from before. In case of violation of this assumption, the estimated meanings may deviate significantly from the real values.

The estimated trend models of total mortality and infant mortality rates were used to predict the period 2022-2025. From the estimated values of the total mortality rates by region and total for the country during the period, a gradual increase is found. According to the forecast calculations, it is found that in most regions and the total for the country, the infant mortality rates are decreasing.

In **paragraph 3.3**, trends are studied and regional features and differences in migration processes are identified.

The mechanical movement of a population consists of a change of domicile, that is to say, in the transfer from one region to another, within the same area or to another country. Migration in the second half of the 20th century is an important factor in the demographic development of the country. The effect of the mechanical movement of the population has a direct impact on the age-sex and territorial structure of the population. Migration movements, along with birth and death rates, affect the natural movement of the population. Since the middle of the last century, there has been a movement of the population from villages to cities, mainly covering young people, as a result of which age structures have changed. The consequences of the migration movement lead to a decrease in the reproduction of the rural population and to its rapid aging.

For the analyzed period 2000-2021, the population in Bulgaria has decreased by 1310.5 thousand. People. The reasons for this decline are based on declining birth rates and rising mortality rates, which in turn lead to increasing negative natural growth. The migration processes of persons of active and reproductive age also affect the size of the population.

The internal migration of the population by region is expressed in the migration of the population both within the respective region and within the borders of the country. The main reasons for this are the search for appropriate realization, obtaining a higher level of education, changing family status, etc. The population rate for the country at the

beginning of the analyzed period (2000) was 25.1‰ and by 2021 there is a small difference – 24.5‰. The internal migration of the population by region is expressed in the migration of the population both within the respective region and within the borders of the country. The main reasons for this are the search for appropriate realization, obtaining a higher level of education, changing family status, etc. The population rate for the country at the beginning of the analyzed period (2000) was 25.1‰ and by 2021 there is a small difference – 24.5‰. In 2021, it already has a value of 24.9‰, which is very close to the national average. In the South-East region, the population rate in 2000 was 25.9‰ and reached 25.5‰ at the end of the period.

The coefficients of settled persons in the regions were calculated and analyzed, whereby corresponding differences were found by regions with the help of the range of variation. Between the North Central and the North-East regions at the beginning of the period, the differences are considerable. At the end of the period, the differences decrease.

Calculations and analyses of the coefficients of evicted persons were carried out for the country as a whole and by region for the period 2000-2021, with the established differences for the entire period being the largest between the North-West and South-West regions.

An important point in the analysis of settled and displaced persons is that there is a parabolic trend – the values of the coefficients decrease for all regions and the country until 2011-2012, then increase until 2020.

In addition to general for the country, internal migration can also be analyzed specifically for each region, i.e. displaced persons from one region to settled in another. Migration also exists within the area itself. It is expressed in distribution between districts, municipalities, settlements – towns, and villages in the respective region.

An analysis of the internal movement of persons by region for the period 2000 – 2021 was carried out, reflecting the state of migration in the same region. There is an internal regional migration between district and district, town and town, town and village, and village and village.

In **paragraph 3.4** a regression analysis of the factor influences on the demographic processes of birth and mortality in regional aspects was carried out.

The study of the influence of economic, demographic, and social factors on the demographic processes of birth and mortality is realized through multifactorial linear regression. In the process of studying the factors that affect the demographic processes in point 1.3 of Chapter 1, several groups of factors were presented, incl. demographic, socio-economic, and psychological. In the process of selection of the factors, only a part of them was selected, and the aim was to include factors that are indicated by the overwhelming number of authors and that are quantifiable, for which there are official data with guaranteed quality of information. These factors are as follows:

$x_1$  – Gross domestic product per capita;

$x_2$  – Old age dependency ratio (population aging);

$x_3$  – Employment rate;

$x_4$  – Average gross salary of employees under a labor contract.

Since the analysis of the indicators of fertility, mortality, and the average age at birth of a child observed trends in their development, often in the parabolic form or of a higher order, the first consecutive differences are used when assessing the factor influence. In addition, a constant and a time trend are included in the models, given that the form of the first differences determines the interpretation of the constant as annual growth, and the parameter ahead of the time trend as an annual acceleration.

The general appearance of the model is as follows:  $\Delta y_t = b_1 \Delta x_{1,t} + b_2 \Delta x_{2,t} + b_3 \Delta x_{3,t} + b_4 \Delta x_{4,t} + a + ct$ ,

Where:  $\Delta y_t$  are the first differences of the performance variable;

$\Delta x_{i,t}$  – the first differences of factor variables;

$b_1, b_2, b_3, b_4, a$  и  $c$  – the parameters of the model.

The estimation of the parameters is done with the method of least squares, and the diagnostic check includes the analysis of the residual elements. The normality check is carried out with the Jacques-Berra test (JB), the autocorrelation checks with the Durbin-Watson test (DW), and the heteroskedasticity checks with the Breuch-Pagan-Godfrey (BPG), White (W) and conditional autoregression heteroskedasticity (ARCH) tests.

Modelling of fertility rates, total fertility rates, average age at birth of first child, mean age at birth of child, mortality rate, and infant mortality rate were carried out.

The following conclusions can be drawn, based on the regression analysis of factor influences on the demographic indicators of birth and death rates:

- The dynamics of the fertility rate are influenced by the average gross wages and salaries of employees under the labor contract, and only in individual cases depend on the age dependency and employment ratios. The impact of the average gross wage and employment is positive, and the age dependency – is negative. The situation is similar to the total fertility rate. It is positively affected by the average gross salary of employees under labor contracts.

- The average age at the birth of a first child depends only on the average gross salary of employees under the labor contract, and then only for the North-West region, the South-East region, and the total for the country. The impact is markedly negative, with rising wages leading to a decrease in the average age at the birth of a first child. Only in the North Central Region is the average gross wage replaced by the gross domestic product per capita, and the impact is also negative. At the mean age at childbearing, no significant influence of any of the factors studied was found.

- Only in the North Central Region is the average gross wage replaced by the gross domestic product per capita, and the impact is also negative. At the mean age at childbearing, no significant influence of any of the factors studied was found.

- The mortality rate depends mainly on gross domestic product per capita, age dependency ratios, and employment. The increase in gross domestic product per capita leads to an increase in mortality, which is an unexpected result, while at the same time, the increase in age dependency and the employment rate leads to a decrease in the mortality rate – also an unusual result. In the dynamics of the infant mortality rate, no significant influence of the analyzed factors is registered.

## **CONCLUSION**

In conclusion, the dissertation in summarized form presented the main results of the empirical and theoretical study of the dynamics of demographic processes and the factors influencing them, based on the defined research purpose and tasks. The established regularities show that the state of the demographic processes has a negative demographic effect, which outlines an unfavorable demographic picture with decreasing



birth rate, high mortality, and high migration intensity in regional aspects and total for the country.

The more significant concrete results of the research carried out can be formulated as follows:

**First**, the essence of demographic processes and the concepts associated with them are clarified – population movement, demographic events, demographic situation, birth rate, mortality, migration, marriage, divorce, etc.

**Secondly**, the measures of demographic processes related to the reproduction of the population – total fertility rate, total fertility rate (specific birth rate), total fertility rate, etc. are pointed out and characterized. To characterize the mortality, the indicators – total death rate, age mortality rates, and infant mortality – are derived.

**Third**, the main factors influencing the individual demographic processes are presented and are combined into three groups – demographic, socio-economic, and psychological factors. It has been found that demographic and socio-economic factors affect both the birth rate and mortality in the country, and psychological factors mainly affect the birth rate.

**Fourth**, several studies of Bulgarian prominent demographers and statisticians on the ongoing demographic processes in different periods of the country's development have been studied, but mainly for the years after 1989. reproduction, reproductive behavior and marriage; Aging; mortality; migration processes.

**Fifth**, a feature is made of the information provision of research on demographic processes in Bulgaria. Population censuses and current statistical reporting are the main sources of information. The nature of the censuses, the date period, their number of holdings, etc. are clarified. The organization of the current demographic statistics is clarified by indicating the main source of information through which the data from the current demographic statistics are obtained – the samples of GRAON-TDS.

**Sixth**, a follow-up of the administrative-territorial structure of the country in the historical aspect, its development after 1990, and the changes implemented were carried out. The classification for the planning areas of level 1, level 2, and level 3 (NUTS1, NUTS2, and NUTS3), according to the requirements of EUROSTAT and the European Commission, is clarified. The criteria for the classification of the hierarchical levels of

territorial units and the differences between the classifications used in the survey period are indicated.

**Seventh,** the state, dynamics, and differences in the birth rate between the regions are analyzed through the indicators fertility rate, total fertility rate, average age at birth of a child, and average age at birth of the first child. A general trend towards a decrease in the birth rate and an increase in the average age at the birth of a child and a first child has been found. The regional specificity is expressed in a slight decrease in the average age at birth of a child in the Northwest and Southeast regions after 2020.

**Eighth,** the condition, dynamics, and regional differences in mortality are studied through the indicators of mortality rate and infant mortality rate. Infant mortality is declining slightly, but in the Northeast region it remains constant and, in the Southeast, it is projected to rise.

**Ninth,** trends, peculiarities, and differences at the regional level in migration processes have been identified. The dynamics of the displaced and settled persons by region are characterized, as well as the structure of the migrated persons between the regions in the country. Intraregional migration was found to have the highest intensity, and when moving to another region the main migration destination was the Southwest region. The exception is migration from the Northeast region, where the largest share of the displaced has passed to the North Central region.

**Tenth,** multifactorial models have been compiled for the influence of factors on demographic processes birth and mortality, and the following four factors are included in the models – gross domestic product per capita; old age dependency ratio; employment rate; average gross wages, and salaries of employees under labor contract. It has been found that the birth rate is mainly influenced by the size of the average gross wage, and the mortality rate – by the gross domestic product per capita, age dependence, and employment.

## DECLARATION

### for Originality

from Diana Ivanova Markova,  
Ph.D. student in an independent form of training  
to the Department „Statistics and Applied Mathematics”  
at the Academy of Economics "D. A. Tsenov" – Svishtov

I declare that the dissertation on "Statistical study of demographic processes in Bulgaria – regional aspects" for awarding the educational and scientific degree "Doctor" in the scientific specialty "Statistics and Demography" is an original author's work. It contains results obtained in scientific studies conducted by me. The results obtained, described, and/or published by other scientists are duly cited in the text and included in the bibliography.

This dissertation has not been applied to the acquisition of a scientific degree at another higher school or scientific institute.

29.01.2024  
Svishtov

Declarant:

(signed)

/Diana Markova/

#### **IV. REFERENCE FOR THE MAIN CONTRIBUTIONS TO THE DISSERTATION**

1. The essence of demographic processes and the concepts associated with them are clarified, indicating the measures characterizing fertility, mortality, marriage divorce, and migration.

2. A systematic analysis of scientific publications on the topic of demographic processes was carried out, and five problem areas were identified: a generalized analysis of the overall demographic picture; reproduction, reproductive behavior, and marriage of the population; aging of the population; mortality of the population; migration processes.

3. After a critical analysis of the problems of demographic processes, the main factors influencing them are outlined, united into three groups – demographic, socioeconomic, and psychological factors, and the specific impact of individual groups of factors.

4. The existence of trends and regional differences in birth and mortality has been proven, and deepening differences in the dynamics of migration processes and the structure of migrants have been identified.

5. Multifactorial models are compiled and the impact on the demographic processes of birth and mortality of selected factors – gross domestic product per capita, age dependency ratio, employment rate, and average gross salary of employees under labor contract is assessed.

## V. LIST OF PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

### I. STUDIES

1. Petkov, P., Slaveva, K., **Markova, D.** et al. (2014). Statistical analysis of socio-economic and demographic differences and inequalities between regions in Bulgaria. *Almanac Scientific Research*, Svishtov: AI "Tsenov", Vol. 21, pp. 384-413.

### II. ARTICLES

1. **Markova, D.** (2012). Statistical analysis of the population according to working capacity for the period 2001-2011 *Annual almanac research of Ph.D. students*, Svishtov: AI "Tsenov", book 5, pp. 269-281.

2. **Markova, D.** (2013). Statistical analysis of the demographic processes in Bulgaria in regional aspect for the period 2000-2012 *Annual almanac research of Ph.D. students*, Svishtov: AI "Tsenov", book 6, pp. 291-310.

3. **Markova, D.** (2014). Regional Differences in the Birth Rate in Bulgaria for the Period 2000-2013 *Economics and Management*, pcs. 2, pp. 130-138.

### III. REPORTS

1. **Markova, D.** (2013). Chronology of the Population Censuses in Bulgaria during the period 1881-2011 *Jubilee International Scientific-Practical Conference "Finance and Economic Reporting – State, Trends and Perspectives"*, 25-26 October 2013, are "D. A. Tsenov". Svishtov: AI "Tsenov", vol. 2, pp. 509-515.