NOVA IMS Information Management School

MDSAA

Master's Degree Program in

Data Science and Advanced Analytics

Demographic Analysis to Support Decision Making

The Migration Response to the Demographic Problem in Portugal

João Miguel Flores Bentes Araújo

Project Work

presented as partial requirement for obtaining a master's degree in Data Science and Advanced Analytics, with specialization in Business Analytics

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

João Miguel Flores Bentes Araújo

Lisboa, 01/12/2024

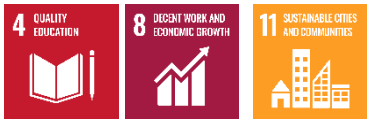
ABSTRACT

The project investigated the demographic problem in Portugal and the migration response to that. The study delved into an analysis of Portuguese population changes over the 21st century, highlighting the influence of migration flows on the demographic dynamics. To anticipate future patterns, the project employed a population projection, using the cohort component method, with diverse migration scenarios, offering insights into potential outcomes. The goal of the project was to support decision makers by offering an extent analysis of Portugal demographic challenges, emphasizing the role of migration. The artifact attempted to contribute providing a tool to understand the data around the demographic aging problem and to support the development of future strategies to respond to the Portugal demographic needs. The finding of the project highlights the vital role of migration in mitigating the effects of population aging. Despite the significant demographic aging observed, migration patterns have shown a positive contribution toward stabilizing population trajectory. The projection suggested that only scenarios with high positive level of migration can effectively reduce the consequences of population aging, assuming other key factors remain constant with the following years. For that, the project underscores the importance of proactive migration policies in addressing demographic imbalances and ensuring sustainable population dynamics and a sustainable society. Furthermore, it highlights the importance of complementary policies that work alongside migration strategies.

KEYWORDS

Demographic analysis; Migration; Population Projection; Cohort Components Method; Data-driven; Microsoft Power BI

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

ANN	Artificial Neural Network
BI	Business Intelligence
CPLP	Comunidade dos Países de Língua Portuguesa
DAX	Data Analysis Expressions
DL	Deep Learning
DSRM	Design Science Research Methodology
INE	Instituto Nacional de Estatística
ML	Machine Learning
OCDE	Organization for Economic Co-operation and Development
PALOP	Países Africanos de Língua Oficial Portuguesa
PBI	Power BI

1. INTRODUCTION

Western societies grapple with an existential challenge concerning their demographic composition. The situation of an inverted demographic pyramid poses a profound threat to the foundational structures on which western societies were built (Schwarz et al., 2014).

Historically, a robust demographic pyramid facilitated the efficiency of social system provided by the state, however the recent aging of population poses a significant risk to the sustainability of the western system (Chesnais, 2000). Portugal stands out among European Nations as a vivid example of these massive challenges.

In the last decades, the Portuguese population has experienced a rapid and consistent aging trend. Between 2011 and 2021, the younger demographic shrank by 15%, while the elderly population notably increased by over 20% (Instituto Nacional de Estatística [INE], 2022b).

The necessity of vigilantly monitoring the geographical trajectories of population dynamics, along with their ramifications on the financial, socio-economic, and political views, is growing more evident. Population dynamics are a catalyst for change and should be carefully analyzed for future rational and sustainable policies (Rodrigues, 2022a).

Simultaneously, there has been a substantial movement of migration, particularly towards developed countries. Portugal has undergone a transformation from being a country of emigration to becoming a country defined by migration (Góis & Marques, 2018). Due to the migration trends in Portugal, demography landscape has become more complex and diverse. In 2022, one in each ten residents in Portugal was a migrant (Organization for Economic Co-operation and Development [OCDE], 2023).

Recognizing that migration flows exert a significant influence on economic and social transformation, it is imperative to understand and analyze migration patterns and how they influence global average demographic dynamics.

Enhancing Data visualization, a diverse array of visualizations facilitates a comprehensive understanding of the situation. The increasing acknowledgment and adoption of dashboards in recent years is showing to be an incredible asset for the institutions, despite some possible challenges of it, as the insufficient data quality, the lack of understanding of data or the poor analysis (Matheus, Janssen & Maheshwari, 2020).

Recognizing the importance of the topic, there is a need for society to gain more understanding of this demographic phenomenon and its susceptibility to migration. It is essential for society and decision-makers to recognize and accurately understand the situation. For that purpose, it is crucial to identify and address the multiple layers of objectives to accomplish during the project process.

- Analyze the evolution of Portuguese demography of the 21st century and execute a population projection for the following years. Within this section, it is important to understand the latest trends, the migration response, and anticipate the upcoming years.
- Examine migration patterns and correlate the data with previous analyze of Portuguese demography. Understand the recent and future trends and the migration response in Portugal for the population aging situation.
- Develop an integrated demographic analysis model to support political, social, and business decision-makers, with a particular focus on understanding the impact of migration patterns on population dynamics.
- Ensure a holistic analysis of population aging challenges. Employ a collection of graphs, visuals, and maps to facilitate decision making and support public policies.

This project plays a critical role in enhancing a comprehension of demographic and migration phenomenon. By leveraging informational dashboards, using a diverse array of pertinent statistics, institutional analytical capabilities will be fortified. The results are expected to contribute significantly to improve the public policies for integration, demographic involvement, and establishment of a pluralistic society.

The project is organized into six distinct chapters.

The first segment encompasses the introduction, where is identified the context and background of the situation. Additionally, are presented the objectives and solutions that the project aims to accomplish.

The second chapter involves the literature review. This segment seeks to comprehend the main topics, the prevailing perspectives, and relevant background information to accomplish the goals previously established. The topics of research are mainly related to population aging, mortality and fertility trends, migration patterns, communication method of data visualization, and data driven decision-making.

The third chapter is centered on producing and crafting the population projection and the dimensional model for producing the metrics and visuals to help data driven decision making.

Chapter four is the vital stage where the project is actively developed. The chapter serves to test if the objectives are being achieved and make the necessary adjustments.

The fifth chapter is devoted to the visuals presentation and evaluation of results. In this section, it will be possible to explore the demographic and geographic trends of population aging and migration patterns.

The sixth chapter, a resume of the work done is presented. Conclusions of the project, limitations and suggestions for future projects based on this one will be communicated.

2. LITERATURE REVIEW

2.1. DEMOGRAPHY

Demography is dedicated to comprehending reality and one of its main objectives is to understand the context and support decision-making. Functioning as a science of analysis, reflection, and action, demography seeks a scientific comprehension of human population dynamics. This encompasses a focus on natural and migratory behaviors, as well as the composition and spatial distribution of population. The goal is to afford a heightened understanding of reality through the identification, analysis, and anticipation of society dynamics (Rodrigues, 2022b).

The global demographic transition initiated in the 20th century, marked by a shift where the working-age population overtaken the younger age cohort. The Second World War was the tipping point. A substantial surge known as the baby boom ensued after the victory against the German regime, contributing to a significant upswing in fertility rates across the Western world. This baby boom is widely acknowledged by researchers as a key driver of the substantial economic growth observed in the following years (Bloom, Canning & Sevilla, 2003).

In the 1960s, due to health improvement, enhancement of working conditions, technological advancements, knowledge dissemination, education perspectives, decline fertility rates, and the reduction in mortality rates, we observed the demographic transition. This trend is observable in Western countries and neither the migration dynamics could change it. The key factors for the demographic transition include the reduction of mortality rates, propelled by healthcare advantages, the shift in the labor market, and the high standard for individual education, which impact the fertility rates negatively (Lutz et al., 2019).

The 'Demographic Transition Theory' emerges as a framework for comprehending the global standard population evolution. The theory elucidates the necessity of society to comprehend the gradual shift from a short and volatile life cycle to an extended life cycle. While the model facilitates the understanding of current and future population characteristics, explains diversity only in terms of growth, without considering the importance of human characteristics and exogenous factors that generate several disparities. Its applicability faces several limitations, particularly at the regional and local levels, because population dynamics are influenced by numerous micro-demographic factors. Consequently, a holistic approach becomes imperative to genuinely grasp the complexities inherent to the subject. (Rodrigues, 2022b).

2.1.1. Portugal demographic dynamics

The demographic trajectory in Portugal had largely aligned with Wester Nations, particularly within European countries. The demographic panorama is changing, with a combination of hyper longevity and exceptionally low fertility rates, producing a progressive inversion of the age pyramid. The phenomenon of population aging is the result of the convergence of the maturation of cohorts, leading to an expansion of the upper segments of the age distribution, and the contraction of the base associated with low fertility regimes (Chesnais, 2000).

In Portugal, the population in the early 20th century stood at approximately 5 million, with consistently modest annual growth rates throughout the century. The 60s experienced notably low growth, while the 70s and 80s saw above-average rates due to the return of Portuguese individuals from the ex-colonies. From the 80s, we can check an evident exodus from the interior to the urban coastal areas, particularly Lisbon. This shift coincided with a tangible decline in the youth demographic, constituting less than 30 percent of the current population compared to the 40 percent in the preceding decades (Nazareth, 1985). The population modification towards coastal areas can be attributed to the industrial urban development that occurred in the mid-20th century (Gomes, 2010). Near the close of the 20th century, it is possible to observe a substantial immigration from Portuguese speaking African Countries (PALOP). Between 1990 and 2000, the foreign resident population in Portugal increased from approximately 110.000 to 210.000, a notable growth of 90% (Peixoto, 2004b).

In the 21st century, Portugal has experienced a decrease in its resident population, particularly between 2010 and 2019, due to negative natural and migration balances. This decline is attributed to the continuous low birth rates, high-life expectancy rates, less immigration flows and an exponential increase of emigration (approximately 350.000 between 2010-2019), due to the international crisis and poor living conditions. However, since 2019 there has been a modest resurgence in population, largely driven by an upswing in immigration. Overall, since the beginning of the 21st century, immigration has been important for the steady increase in the active resident population, with approximately 90% responsibility for the population increase (Rodrigues, 2022a).

Portugal stands out globally for having one of the lowest fertility rates (1.35 in 2021) and with one of the highest average life expectancies (83.5 years for female, 78.1 years for male in 2021). Simultaneously, the nation has achieved remarkable progress in reducing the mortality rate, establishing itself again as one of the top countries in that matter (2.4 deaths per 1000 live births in 2021). These indicators contribute to the observation that approximately one in five residents is aged over 65, reflecting the complex problem of the inverted population pyramid (Instituto Nacional de Estatística [INE], 2022a).

In what concerns global ageing dynamics, Portugal already leads negative forecasts, being the 7th world's oldest country, and the 2nd oldest of the European Union (after Italy). Demographic projections indicate a steady increase in the population aged 85 and above, while the younger

population is anticipated to be less than 25% of the total population. The overall population volume is expected to decrease to levels similar to the 1990s, approximately 8 million. By the year 2050, it is projected that only one in eight residents will be below the age of 15. While the population may decrease, there is a potential for improved health and educational scores. The reduction in quantity is offset by gains in quality, competence, and information. By the year 2030, it is anticipated that the proportion of individuals lacking basic education will fall below 25%, and 25% will hold a bachelor's degree. The population will be more diverse in origins and cultures (Rodrigues & Henriques, 2017).

In 2013, the Portuguese government declared demographic aging as a vulnerability, both economic, social, and of security ('Conceito Estratégico de Defesa Nacional, 2013). The report advocates the implementation of new policies to stimulate fertility, reinforcement of migration integration, and to manage the challenges posed by population aging. Key measures recommend encompass initiatives to enhance the fertility rate, including policies offering tax incentives for families, work-life balance, and fortifying support systems for children's education and healthcare. Additionally, measures to improve the capacity to attract immigrants and not just labor workers. Furthermore, the report underscores the significance of employment and education policies, with measures designed to facilitate the entrance of young workers into the market and prevent the premature exit of older workers (Rodrigues, 2022a).

2.2. DEMOGRAPHY EXTERNALITIES

The phenomena give rise to several non-demographic implications that extend across social, economic, and political dimensions (Bloom, Canning & Fink, 2010).

The beginning of the workforce aging yielded economic advantages, due to a decline in the youth population, and consequently a significant proportion of the population is considered active workforce. This primary gain is often referred to as the 'demographic bonus' or 'demographic dividend'. After this initial positive externality, negative consequences usually appear, such as the rigidness and less adaptability of the labor market (Bloom, Canning & Sevilla., 2003). The pronounced aging of the population poses a challenge to the revitalization of the labor market (Mendes et al., 2016). Nevertheless, the aging population presents opportunities for the emergence of new markets, particularly in sectors orientated to the older population, such as medical care, and social services (Chesnais, 2000). Moreover, the aging population can have a positive impact on mitigating the unemployment rate, particularly the youth unemployment rate (Mendes et al., 2016).

The comprehension of political externalities is more intricate. An aging and declining population tends to exhibit prone for maintaining the status quo. The influence of the senior demographic cohort is notable and there is a demand for a substantial allocation of state resources to address their specific needs. This situation can develop enormous social tension and lead to an intergenerational conflict. The substantial electoral proportion by the elderly

demographic cohort can induce a hesitancy among political authorities to implement the necessary socio-economic policies to respond to the prevailing trends (Chesnais, 2000).

The disparity in the consumption to production ratio is evident across the different generations. The intergenerational clash can be exacerbated by disparities in values, beliefs, and lifestyles that have changed significantly (Bloom, Canning & Sevilla., 2003).

Beyond the impact on the healthcare system, the aging of the population exerts significant pression on the existing social security system in Western societies, as in Portugal, due to its Welfare structure, as known as 'pay-as-you-go'. Founded on the principle of intergenerational solidarity, the social security system's sustainability relies on the guarantee of intertemporal sustainability, a prospect currently jeopardized by the fear of system insolvency. While facing several challenges, the population aging is classified as one of the biggest threats to the actual Welfare system structure. In 1997, family related expenditures constituted 17% of total social security spending, a figure that decreased to 5% in 2016. The transformation in age distribution has far-reaching implications for the dynamics between taxpayers and pensioners, underscoring the urgent need for comprehensive reforms to ensure the resilience and efficiency of the Welfare system (Coelho, 2022).

2.3. MIGRATION

In the last few decades, migratory dynamics have held significance on a global scale. Migration has emerged as an important factor that has socioeconomic externalities and presents both challenges and opportunities.

The dissolution of barriers and technological advancements, particularly in transportation and communication, have led to closer people all over the world. While migration can stimulate economies and societies at both country of origin and destination, it poses diverse concerns. In the current state of the world, there are different economic growths, different human development, regional discrepancies, and inequalities that challenge the geopolitical balance and propelling migratory dynamics. Globalization, acceleration, diversity, and differentiation of migration are evident trends in the 21st century. Migration patterns are reactive to economic and social disparities between nations. Additionally, the surge of migration, stemming from political crises, conflicts, environmental catastrophes, and climate change, constitutes a critical factor that could intensify the dynamics of migration and its consequences (Rodrigues & Ferreira, 2014).

The concept of 'replacement migration' emerged towards the end of the 20th century, at a moment that crucial questions addressing the challenges about population aging started to be posed. The concept is characterized by the movement of migrants to offset the decrease in the population's natural growth, thus mitigating the trends of population aging and decline. Several studies on this subject underscore the challenge of addressing population aging situation, only managing migration dynamics. It is highlighted that such an approach, without considering the socioeconomic and political factors, may lead to unexpected repercussions.

At same time the projections from numerous studies, said that excluding migrations, it is not possible to requisite the enough human and financial resources to stabilize the welfare system. It is necessary to have a comprehensive approach encompassing migration as well as the formulation of cohesive socioeconomic and demographic policy to mitigate population aging (Peixoto et al., 2017).

2.3.1. Portugal migration

Historically, Portugal was characterized by emigration, although in the 90s, following its admission to the European Economic Community (EEC), Portugal transformed into a country of migration, with a constant emigration but with immigration too. This transformation was propelled by changes in the political regime, economic changes and subsequent social modernization. The downfall of the political regime and the repatriation of Portuguese citizens from ex-colonies in the 1970's was an important period, where the first significant flow of immigrants came to Portugal. Subsequent that, enormous numbers of immigration came, particularly from Community of Portuguese Language Countries (CPLP). The pre-existing cultural and linguistic ties between the nations and Portugal was the rationale reason for those immigration dynamics (Peixoto, 2004a).

Throughout the 21st century, there has been a shift in Portugal demography. The significance of PALOP citizens has diminished, while an increase in immigration from northern Europe, Eastern Europe, and particularly Asia has been observed, each of them driven by distinct purposes. The period between 2009 and 2016 witnessed a negative migratory balance, heavily influenced by the international financial crisis, resulting in significant impacts for Portugal (Góis, 2019). In recent years, after 2019, due to less bureaucracy in migration process, there has been a resurgence of immigration patterns. This recent dynamic is incorporated by individuals from Brazil and Asia countries, including India, Nepal, Pakistan, and Bangladesh. In 2022, there were more than 750.000 foreign residents in Portugal. Brazil accounts for around 30% of the total foreign community, while those from the PALOP countries represent less than 15%. The recent trends emphasize migration from Asia, with similar figures than PALOP countries (Fialho, Lopes & Machado, 2022).

The immigrants exhibit diversity in their characteristics according with their nationality and their stage in the migration cycle time. PALOP nationalities display lower educational accomplishment and reduced professional qualifications, often opting to establish themselves in the Lisbon and Algarve regions. On the contrary, individuals from East Europe are characterized by a higher level of education and a distribution across the country. Despite these differences, there is a similar professional integration for Eastern European, with many of them finding employment in unskilled positions, such as construction and domestic services. Individuals from the South American continent, particularly Brazil, exhibit moderate qualifications and integration levels, due to is culture proximity with Portugal, and are dispersed across all the Portuguese territory. From North Europe and North America, the immigrants are characterized by high levels of qualifications and quality of life. Portugal has

two distinctive labor markets, one segment for nationals and another for foreigners (Rodrigues & Henriques, 2017).

Emigration, a permanent feature of Portuguese society, unfolds across four different cycles. The initial cycle, spanning from 19th century to the mid-20th century, were approximately 2 million Portuguese daring to explore the 'new world', Brazil and USA. Subsequently, a second phase towards European nations, as France and Germany. The third cycle, beginning in the late of 80s with Portugal's accession to the European Union. In this period, Portuguese emigrates privileged Switzerland and Luxemburg as destination country. The most recent phase emerged at the end of the 20th century, characterized by movement within European Union, involving both permanent and temporary emigration among several Nations. This contemporary emigration cycle is marked by discernible trend of a progressive outflow of highly qualified individuals. In the 21st century, Portuguese citizens prefer to emigrate to European countries, such as France, Switzerland, Spain, United Kingdom, Luxembourg, Netherlands, and Belgium (Góis, 2019). In 2021, in cumulative terms, the number of Portuguese emigrants was approximately 2.5 million, representing around 25% of the resident population in Portugal. Portugal stands out globally as one of the nations with the highest diaspora. (Pires et al., 2022).

2.4. MIGRATION EXTERNALITIES

Migration develops diverse consequences, depending on an unknown number of exogenous factors.

Immigration, as a dynamic component, holds the potential to decelerate the aging demographic and subsequently have a positive impact on fertility rates. By augmenting the young working population, it contributes to an increased pool of labor, enhancing productivity. This could be a vital element to ensure the viability of social security. Furthermore, immigration introduces culture enrichment and promotes a more pluralistic society. It also serves to stimulate the repopulation of less inhabited areas, fostering greater demographic dynamism. The positive externalities of immigration range the economic sphere, increasing competitiveness, tax revenues and contributions to public funding. On the social side, immigration contributes to demographic vitality, encouraging progress and cultural richness. On the contrary, immigration may entail adverse repercussions. The influx of low-skilled immigrants with divergent cultural values and low overall educational levels could potentially difficult their integration in society. The high immigration levels may enable significant transformation in society, promoting social and political tensions. Moreover, heightened immigration rates could correlate with an increase in illegal immigration. These factors collectively contribute to a potential decrease in the security perception. Simultaneously, the migration complexities may exert increased pressure on the public services, such as healthcare, education, and social security (Rodrigues & Henriques, 2017).

Emigration entails a range of effects, incorporating both positive and negative aspects. From an economic perspective, the sending money and the acquiring knowledge represents an added value to the economy of the origin country. On the contrary, brain drains lead to a reduction in productivity. Additionally, emigration, within the working-age cohort, may contribute to a decline on fertility levels in the country of origin (Rodrigues & Ferreira, 2014).

2.5. POLICY RESPONSES

The demographic challenge posed by population decline and aging process requires a comprehensive institutional answer from all nations, particularly the Western nations.

There are essential vectors for managing a potential intervention on the population decline and aging situation. These policies underline the notion that demography can act as a driver for the economy, or conversely, that economy can function as a driver of demography (Rodrigues, 2022a).

Nations may choose to accept population decline as an inherent demographic trajectory and redirect efforts towards other vectors, that not migration policies. This approach aims to avoid potential challenges associated with large scale immigration. Governments have the potential to address the challenges of an aging population through measures that include the liberalization of retirement aging policies and enhancing retirement pension flexibility. Adding to that, the countries can set realistic expectations to citizens about the real retirement pension amount that is possible to pay, by fostering intergenerational dialogue, which guarantees the sustainability of society. Governments can invest in health promotion to increase the health and productivity of the senior population. Lastly, adjustments to social security and pension policies are essential, attempting to strike a balance between generations (Bloom, Canning & Sevilla, 2003).

To act against the adversity of population aging and decline, countries can strategically boost the migration dynamics or the natural dynamics. Facilitating conditions for immigration and retaining emigration prove more implementable in the short-term, while addressing the fertility rates necessitates an overlong timeframe and increased resources. The efficiency of migration policies relies heavily on integration strategies. A focus on migration and integration policies may be fundamental, aiming to augment the capacity to attract immigrants and preserve existing population. Subsequently, family policies should be considered, incorporating measures to establish better fiscal equity for families, introducing flexible work contracts, and reinforce the education and health public system. Employment and education policies are valuable against the situation, incorporating measures to facilitate the entry of young individuals into the labor market and prevent premature exit of active-age workers (Rodrigues, 2022a).

In resume, for future policies to address the challenges of population aging, it is vital to detect two key trajectories. The demographic vector entails the implementation of realistic fertility policies, emphasizing the concept of family, and encouraging a favorable environment for

sustainable migration. The second vector involves measures aimed to fortify society, such as enhancing health outcomes, investing in education, and promoting employment flexibility (Rodrigues & Henriques, 2017).

2.6. POPULATION PROJECTION – COHORT COMPONENTS METHOD

The Cohort Component Method stands out as the predominant approach employed by world institutions for population projections across different geographic scales, whether it be at national or regional level. The method offers versatility, accommodating diverse data sources, methodologies, and assumptions (Bravo et al., 2018).

To enhance the precision of projections, the population is separated based on age and gender. This split facilitates a nuanced examination of crucial factors such as mortality, fertility, and migration. The age cohorts usually are defined in a 5-year group and the oldest cohort is typically 85+. It is evident that an individual's age and gender impacts mortality rates, fertility trends, and migration data (Smith, Tayman & Swanson, 2013).

In recent times, the Cohort Component Method has experienced slight refinements and has been dissected, while machine learning (ML) and deep learning (DL) models have emerged as potential alternatives for population projections. Recent studies, such as one containing Artificial Neural Network (ANN) models (Riiman et al., 2019), have generally revealed better performance using the Cohort Component Method. However, results indicate that with improvements in model parameters and the introduction of additional information, other models also have the potential to surpass Cohort Component Method predictive abilities. Additional research indicates that integration of ML algorithms into methodology may be important. The ML models can be used to generate the parameters and input predictions that are used in the Cohort Component Method. Parameters like mortality rates, fertility rates, and migration trend can be forecasted by the ML models and subsequently these estimations can be incorporated into the eventual population projection, using the Cohort Component Method (Sahinarslan, Tekin & Cebi, 2021).

2.7. DATA-DRIVEN DECISION MAKING

Globalization and organizations' expansion have become dependent upon technology to support the decision-making process. The institutions must implement an organized system of information to improve their decision method, with data collection and analysis that can convert into beneficial outcomes (Nanda & Kumar,2022).

Institutions have been actively exploring strategies to boost the speed and precision of their decisions by using existing data. In the Era of big data, it has become necessary for organizations to adopt data-driven decision-making, Elevating the efficiency of their decision processes. To ensure the accuracy of data-driven decisions, institutions must prioritize the data quality and their capabilities to analyze it. The capacity to execute data-driven decisions is characterized by an organization's proficiency to use information (Jia, Hall & Song, 2015).

The decision-makers depend on assumptions, premises, and context. The context and assumptions represent external aspects (Diván, 2017).

To possess a data-driven decision-making ability, an institution must excel in governance, data analysis, and performance management. Data governance refers to the capacity of an institution to provide data with appropriate levels of timeliness, accuracy, reliability, and security. Data collection, data integration, data quality, and data access are included in data governance framework. Data analytics capability is defined as the capability to evaluate and interpret data, which is combined with existing information to generate knowledge to support decision-makers. Visualization, exploration, and predictive are types of analytics used by institutions to reflect the analytics methods, such as statistics, ML, and optimization. Organizations should develop their processes based on objectives to be possible to monitor outcomes. The capability of performance management defines the ability to build an appropriate system to measure business and then guide the decision-makers actions accordingly with the outcome. Finally, it is imperative that an organization has the capability to integrate all the distinct assets and processes into a unified system. Process integration capability reflects the institutions' ability to integrate its information flows among different parties (Jia, Hall & Song, 2015).

2.8. DATA VISUALIZATION

Information technologies, such as business intelligence (BI) or big data systems, serve as potential platforms for collecting and organizing information to support decision makers. The significant difficulty lies in delivering and communicating the information in a clear and user-friendly way. The challenge is not merely to generate maps or graphs but to craft comprehensive visualizations that truly enhance the decision-making process (Burnay, Dargam & Zaraté, 2019).

The challenges of competent data visualization include insufficient data quality, lack of understanding of data, wrong interpretating, and poor analysis. These encounters can result in misconceptions and wrong decisions (Matheus, Janssen & Maheshwari, 2020).

Executives are required to make the correct strategic decisions, understanding the strengths and weaknesses of their institutions, and guessing potential externalities. Data visualization has emerged as a valuable tool, aiming to present information, helping executives to act rapidly and precisely. Data visualization is significant in presenting complex data by summarizing amounts of data for effective human interpretation. A visual should provide clarity, simplicity, insightfulness, and capability to support the objectives of the decision makers (Moore, 2017).

The shifting focus for end-users with better and more effective data presentation is a global phenomenon. Data visualization helps BI users at different levels from different perspectives. The objectives of data visualization are focused on human information seeking and decision-making behaviors, visualizing key metrics for fast and easy comprehension, and providing a

visual and interactive way to explore data. Visualization assists the cognitive load of information processing and helps the data memorization (Zheng, 2018).

3. METHODOLOGY

The Design Science Research Methodology (DSRM) attempts to advance human knowledge through the development of artifacts aimed at solving real-world challenges. The goal of DSRM is to extend the boundaries of human capabilities by crafting novel artifacts in the form of models and methods (Brocke, Hevner & Maedche, 2020).

The DSRM is a proactive perspective towards technology to permit organizations to tackle significant challenges. However, an excessive focus on technological artifacts and the risk of neglecting theoretical foundation can be a vulnerability, resulting in well-designed artifacts that are useless in the real-world (Hevner et al., 2004).

The DSRM process model includes six stages, providing a comprehensive framework for guiding research projects, incorporating fundamental principles and practices (Peffers et al., 2007).

The initial phase of DSRM model involves the problem and motivation identification. Adding to that, it is important to assess the potential value of the proposed solution. The project confronts the challenges of population aging. The solution presented is the development of demographic analysis tools, assisting decision-makers to address the population aging situation and understanding the migration response to that.

Subsequently, the second step involves the specification of solution objectives. The objective is to create a comprehensive set of tools, dashboards, and visuals to analyze the available and relevant data. In the end, the main goal is to provide support for public decision-making.

The third step is the construction and development of the design, producing the artifact that can effectively address the predetermined objectives. The process will start with a complete demographic analysis spanning the past two decades in Portugal and a population projection for the next following years. Subsequently, the plan includes the integration of migration data into the analysis and correlate both.

The fourth stage has the objective to demonstrate the application of the artifact.

The fifth step holds the evaluation of the artifact. This process involves the comparation of the initially defined objectives for the solution with the observable results.

The last phase of the DSRM model implies communicating the entire process. The essentials will be present in this document.

3.1. COHORT COMPONENTS METHOD

The initial phase establishes the population projection process through the Cohort Component method. The method will enable the comprehension of the population's dynamics and the impact of migration.

The demographic projection, executed using the support of excel, employed the Cohort Component method for the population, geographically distributed by NUTS II. The method encompasses three key factors influencing population variation: fertility, mortality, and migration. By separating the population into components based on sex and age, facilitates the analysis of population dynamics along the years.

The project aims to estimate the population from 2021 to 2031, a 10-year cover. The initial phase requires a 5-year projection, followed by another 5-year projection incorporating the assumptions calculated in the first projection. It is imperative for the method to have reliable birth, deaths, and migration data. The information needed was extracted from the INE website.

Demographic information was gathered categorically by gender and across different age sets, from 0-4 years old up to +85 years old, segmented into 5-year intervals, for every NUTS II region. The data has been compiled from 2001 to 2021, with updates of 5-years. Complementing that, projections were generated for 2026 and 2031.

The outcomes are influenced by the population's structure and its trajectories in terms of fertility, mortality, and migration changes. The application of this process allows the conception of various scenarios. As the comprehend of the migration responds to the demographic challenges in Portugal is one of the project's objectives, the method exclusively encompassed various migration scenarios, assuming the same trajectories in the fertility and mortality assumptions during the studied period.

In terms of fertility projections, to estimate the number of births expected, the project computed fertility rates for women. By employing these fertility rates alongside the total count of women on reproductive age, it was possible to forecast the expected number of births throughout the duration of the study period. In addition to predicting births, it was imperative to determine the surviving population transitioning from an age group to another age group, for each gender, utilizing data about the number of deaths and the total population.

To assess the forthcoming effect of migration on Portugal's population, it was computed a 5-year migration balance average, from 2017 to 2021, for each NUTS II region. Subsequently, we formulated four distinct scenarios outlining the trajectory of population from 2021 to 2031, each with different migration balance dynamics. The project developed a "Without Migration" scenario to enable better comparations and analysis. After the project built a scenario with a non-evolution perspective in the migratory balance, maintaining the average

of the preceding five years as the benchmark for all years up to 2031, the 'Low Scenario'. Additionally, a 'Moderate Scenario', projecting a 5% annual growth rate until 2031, and a 'High Scenario' was formulated, envisioning a 10% growth rate between each consecutive year.

3.2. DATA DIMENSION MODEL

In accordance with the principles of DSRM, the project centers on developing an artifact to meet specific objectives. This chapter corresponds to stages 3 and 4 of the DSRM, focusing on the design and development of data dimensional model and data analysis tool. It outlines the processes involved in structuring and optimizing the data model to serve as an effective tool for decision-makers.

A necessary step involved the extracting of important and critical statistics for the intended analysis, including comprehensive information related to population dynamics and migration patterns.

The ultimate phase of the process involved the integration of these insights into a comprehensive, data model, designed to harmonize diverse datasets within an architecture optimized for visualization. Power BI (PBI) was employed to deliver robust visuals, graphs, and dashboards, providing decision-makers with intelligence.

3.2.1. Data Flow

Data sources for the dimensional model were gathered on excel format, from various certified governmental institutions, including INE, Pordata, and additional observatories.

Data importing, cleaning, transformation, and modeling were conducted using the Power Query module, a feature of PBI platform. The ETL (Extract, Transform, Load) process was significant to ensure data consistency and quality. During the process, a panoply of techniques and operations were applied, and a multidimensional "Constellation Schema" model was compiled. The model facilitates data visualization by employing relational connections across different datasets, enabling seamless integration of information for comprehensive analysis.

3.2.2. Data Dimension Model Architecture

This section presents the data model architecture that formed the Constellation Schema, design where multiple fact tables are associated with several dimension tables. The model was designed with a focus on achieving an organized data structure and an integrated data model.

The architecture comprises twelve fact tables and ten dimension tables (Figure 1 – Data Dimensional Model), constructed to provide a structured and scalable foundation.

Figure 1 - Data Dimensional Model (Own Elaboration)

3.2.3. Tables, measures and indicators construction

The core aspect of the dimensional model design and interactive visualization is the strategic creation of tables, columns, calculated columns, and measures. These elements form the backbone of the data structure, enabling calculations and metrics that support in-depth data analysis. The calculated columns and measures were built using Power Query Editor and Data analysis Expressions (DAX), the programming language designed for data analysis tasks, inside PBI.

Dimension Tables:

- Date Dimension:

Table – “Dim_Date”

Columns – “Year”, “SK Date”

- Region Dimension:

Table – “Dim_Region”

Columns – “Region”, “SK Region”

- Country Dimension:

Table – “Dim_Country”

Columns – “Country”, “SK Country”

- NUTS II Dimension:

Table – “Dim_NUTS II”

Columns – “NUTS”, “SK NUTS II”

- NUTS III Dimension:

Table – Dim_NUTS III”

Columns – “NUTS III”, “SK NUTS”

- District Dimension:

Table – “Dim_District”

Columns – “District”, “SK District”

- Gender Dimension:

Table – “Dim_Gender”

Columns – “Gender”, “SK Gender”

- Migration Type Dimension:

Table – “Dim_Migration Type”

Columns – “Migration Type”, “SK Migration Type”

- Age Dimension:

Table – “Dim_Age”

Columns – “Age Cohort”, “SK Age”

- Education Level Dimension:

Table – “Dim_Education Level”

Columns – “Education level”, “SK Education Level”

Fact Tables:

- Resident Population:

Table – “Fact_Resident Population in Portugal”

Columns – “Resident Population (Nº)”, “NUTS III”, “Age Group”, “Gender”, “Year”, “FK NUTS”, “FK Age”, “FK Gender”, “FK Date”

Calculated columns – “Age Group II”

Measures – “% Resident Pop.”

- Population Balance:

Table – “Fact_Population Balance in Portugal”

Columns – “Migratory Balance”, “Natural Balance”, “NUTS III”, “Year”, “FK NUTS”, “FK Date”

Calculated columns – “Population Balance”

- Population density:

Table – “Fact_Population Density in Portugal”

Columns – “Population density”, “NUTS III”, “Year”, “FK NUTS”, “FK Date”

Measures – “Density Variation”

- Births and deaths:

Table – “Fact_Births and Deaths in Portugal”

Columns – “Births (Nº)”, “Deaths (Nº)”, “Year”, “NUTS III”, “FK Date”, “FK NUTS”

Calculated columns – “Natural Balance”

- Birth and mortality rates:

Table – “Fact_Birth and Mortality Rates in Portugal”

Columns – “Gross Birth Rate ‰”, “Gross Mortality Rate ‰”, “NUTS III”, “Year”, “FK NUTS”, “FK Date”

- Portuguese Emigration:

Table – “Fact_Portuguese Emigration”

Columns – “Portuguese Resident Population (Nº)”, “Portuguese Entries (Nº)”, “Region”, “Country”, “Year”, “FK Region”, “FK Country”, “FK Date”

Measures – “% Portuguese resident per country”, “Portuguese Resident Variation”

Table – “Fact_Portuguese Emigration_x”

Columns – “Emigration (Nº) in Portugal”, “Migration Type”, “Gender”, “Year”, “FK Migration Type”, “FK Gender”, “FK Date”

Table – “Fact_Portuguese Emigration_xx”

Columns – “Proportion of Permanent Emigration in Portugal”, “Education Level”, “Year”, “FK Education Level”, “FK Date”

Measures – “Emigration Proportion Variation”

- Immigration Population:

Table – “Fact_Immigration Population in Portugal”

Columns – “Immigration population in Portugal (Nº)”, “Region”, “Year”, “Country”, “District”, “Gender”, “FK Country”, “FK District”, “FK Gender”, “FK Region”, FK Date”

Measures – “% Immigration per country”, “% Immigration per district”, “% Immigration per gender”, “% Immigration per region”

Table – “Fact_Immigration Population in Portugal_x”

Columns – “Immigration population in Portugal (Nº)”, “Country”, “Gender”, “Region”, “NUTS III”, “Year”

Measures – “% Immigration per NUTS”, “% Immigration per gender_x”, “% Immigration per region_x”

- Foreign Population:

Table – “Fact_Foreign Population in Portugal”

Columns – “Foreign population with legal resident status”, “Country”, “NUTS III”, “Region”, “Year”, “FK Country”, “FK Date”, “FK NUTS”, “FK Region”

Measures – “Foreign Population Variation

- Population Projection:

Table – “Fact_Population Projection”

Columns – “Population”, “Migration Balance”, “Age Cohort”, “Gender”, “NUTS II”, “Year”, “Notes”, “FK Age”, “FK Gender”, “FK NUTS II”, “FK Date”

Calculated columns – “Scenario”, “Total Population”, “Age Cohort II”

4. RESULTS AND DISCUSSION

Throughout the execution of projection processes, it is imperative to analyze and interpret the emerging outcomes. This step allows us to understand if the findings are aligned with the precedents documents and literature that was covered.

4.1. COHORT COMPONENTS METHOD

To perform an analysis of the cohort components method, it is crucial to grasp the insights it yields. For that reason, it is necessary a comprehensive examination of the population dynamics and evolution during the studied period, enabling an understanding of both historical trends and projected estimations derived from the various migration scenarios generated.

In 2001, Portugal had a population close to 10.4 million people. Approximately 23% of the population were young, under the age of 19, while only 17% were elderly, aged over 65 years. The potentially active population, aged between 19 and 64, accounted for about 6.3 million individuals. Regarding the number of births, Portugal had over 110.000 births, with the majority occurring in the region of 'Norte' and 'Lisboa'. The 'Alentejo' territory had the highest percentage of the elderly, nearly 23%, while the 'Norte' and the Portuguese islands, 'Azores' and 'Madeira', had the highest proportion of the young population (Table 1 – Portugal Population in 2001).

Table 1 - Portugal Population in 2001 (Own Elaboration based on INE)

2001	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	112.825	41.471	22.415	31.604	6.825	4.164	3.129	3.160
Youth Cohort (< 19)	2.342.795	905.356	500.692	561.746	152.972	83.481	71.651	66.897
Youth Cohort (< 19) %	22,5%	24,5%	21,3%	21,0%	19,7%	20,8%	29,5%	27,0%
Youth Cohort (Male)	1.202.866	465.252	256.848	287.739	78.891	42.850	36.946	34.340
Youth Cohort (Male) %	51,3%	51,4%	51,3%	51,2%	51,6%	51,3%	51,6%	51,3%
Adults (20-64 | Active Population)	6.329.457	2.267.397	1.387.197	1.698.388	447.750	242.371	139.533	146.821
Adults (20-64 | Active Population) %	60,9%	61,3%	59,0%	63,4%	57,7%	60,5%	57,5%	59,2%
Adults (20-64 | Active Population) (Male)	3.098.855	1.106.793	680.326	826.042	223.454	122.245	70.148	69847
Adults (20-64 | Active Population) (Male) %	49,0%	48,8%	49,0%	48,6%	49,9%	50,4%	50,3%	47,6%
Senior Cohort (+65)	1.722.417	523.580	463.763	418.561	175.774	75.085	31.360	34.294
Senior Cohort (+65) %	16,6%	14,2%	19,7%	15,6%	22,6%	18,7%	12,9%	13,8%
Senior Cohort (+65) (Male)	717.653	216.023	196.264	169.299	77.066	33.404	12.902	12.695
Senior Cohort (+65) (Male) %	41,7%	41,3%	42,3%	40,4%	43,8%	44,5%	41,1%	37,0%
Total Population	10.394.669	3.696.333	2.351.652	2.678.695	776.496	400.937	242.544	248.012

The population of Portugal, in 2011, rose to over than 10.5 million. The proportion of young individuals declined approximately 200.000 individuals compared to 2001, representing only 20% of the population in 2011. Meanwhile, the elderly age segment increased to 19% of the

total population. Notably, alongside the 'Alentejo' region, the 'Centro' also exhibited a significant number of elderly residents, exceeding 22% of the population in that territory, while in 'Alentejo', the elderly segment reached close to 24% of the region's population. Furthermore, the number of births dropped under the 100.000 births, less 15.000 than 2001 (Table 2 – Portugal Population in 2011; Table 3 – Portugal Population Variation (2001 – 2011)).

Table 2 - Portugal Population in 2011 (Own Elaboration based on INE)

2011	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	96.993	31.525	18.342	31.127	6.145	5.276	2.748	1.288
Youth Cohort (< 19)	2.140.602	760.783	437.343	589.463	138.093	93.263	60.802	60.855
Youth Cohort (< 19) %	20,3%	20,7%	18,8%	20,9%	18,3%	20,6%	24,6%	22,8%
Youth Cohort (Male)	1.095.218	388.652	224.146	301.208	70.893	47.881	31.195	31.243
Youth Cohort (Male) %	51,2%	51,1%	51,3%	51,1%	51,3%	51,3%	51,3%	51,3%
Adults (20-64 | Active Population)	6.393.810	2.290.198	1.371.736	1.705.081	434.952	271.260	153.499	167.084
Adults (20-64 | Active Population) %	60,6%	62,2%	58,9%	60,4%	57,6%	60,0%	62,1%	62,5%
Adults (20-64 | Active Population) (Male)	3.103.940	1.109.244	670.004	815.081	217.808	133.668	77.202	80.933
Adults (20-64 | Active Population) (Male) %	48,5%	48,4%	48,8%	47,8%	50,1%	49,3%	50,3%	48,4%
Senior Cohort (+65)	2.024.538	632.890	520.508	528.785	182.308	87.798	32.794	39.455
Senior Cohort (+65) %	19,2%	17,2%	22,3%	18,7%	24,1%	19,4%	13,3%	14,8%
Senior Cohort (+65) (Male)	839.231	261.754	215.328	220.004	76.774	38.466	13.139	13.766
Senior Cohort (+65) (Male) %	41,5%	41,4%	41,4%	41,6%	42,1%	43,8%	40,1%	34,9%
Total Population	10.558.950	3.683.871	2.329.587	2.823.329	755.353	452.321	247.095	267.394

Table 3 - Portugal Population Variation (2001 – 2011) (Own Elaboration)

Variations (2001 – 2011)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	-15.832	-9.946	-4.073	-477	-680	1.112	-381	-1.872
Births %	-14%	-24%	-18%	-2%	-10%	27%	-12%	-59%
Youth Cohort (< 19)	-202.193	-144.573	-63.349	27.717	-14.879	9.782	-10.849	-6042
Youth Cohort (< 19) %	-9%	-16%	-13%	5%	-10%	12%	-15%	-9%
Adults (20-64 | Active Population)	64.353	22.801	-15.461	6.693	-12.798	28.889	13.966	20.263
Adults (20-64 | Active Population) %	1%	1%	-1%	0%	-3%	12%	10%	14%
Senior Cohort (+65)	302.121	109.310	56.745	110.224	6.534	12.713	1.434	5.161
Senior Cohort (+65) %	18%	21%	12%	26%	4%	17%	5%	15%
Total Population	164.281	-12.462	-22.065	144.634	-21.143	51.384	4.551	19.382
Total Population %	2%	0%	-1%	5%	-3%	13%	2%	8%

By 2021, the demographic landscape of Portugal had undergone significant transformations. In 2021, the total of the population was 10.4 million individuals, about a quarter of the population was aged over 65 years old, while only 18% fell within the young age group. Over the decade between 2011 to 2021, the elderly age segment had an increase of roughly 400.000 people, while the young age cohort had a decline of 250.000. Additionally, the potentially active age cohort experienced a decrease exceeding 300.000 individuals over the

same period. Moreover, the shrinking number of births, around 80.000 in 2021, fewer 20.000 than in 2011, boosts the population aging pattern. The region of 'Lisboa' stood out as the most dynamic region with the highest percentage of young and adults' population (Table 4 – Portugal Population in 2021; Table 5 – Portugal Population Variation (2011 – 2021)).

Table 4 - Portugal Population in 2021 (Own Elaboration based on INE)

2021	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	79.795	24.825	14.891	26.723	5.235	4.119	2.048	1.744
Youth Cohort (< 19)	1.886.718	629.765	376.734	572.817	123.995	87.889	49.034	46.484
Youth Cohort (< 19) %	18,1%	17,4%	16,7%	19,9%	17,4%	18,7%	20,5%	18,4%
Youth Cohort (Male)	964.981	322.033	192.981	292.712	63.353	45.050	25.144	23.708
Youth Cohort (Male) %	51,1%	51,1%	51,2%	51,1%	51,1%	51,3%	51,3%	51,0%
Adults (20-64 | Active Population)	6.072.755	2.153.627	1.265.010	1.681.166	398.111	269.984	149.675	155.182
Adults (20-64 | Active Population) %	58,3%	59,7%	56,2%	58,3%	55,8%	57,4%	62,7%	61,4%
Adults (20-64 | Active Population) (Male)	2.945.475	1.042.742	618.315	802.809	200.427	131.872	74.312	74.998
Adults (20-64 | Active Population) (Male) %	48,5%	48,4%	48,9%	47,8%	50,3%	48,8%	49,6%	48,3%
Senior Cohort (+65)	2.461.644	826.586	610.904	629.662	191.270	112.110	40.085	51.027
Senior Cohort (+65) %	23,6%	22,9%	27,1%	21,8%	26,8%	23,9%	16,8%	20,2%
Senior Cohort (+65) (Male)	1.056.806	358.347	265.039	262.414	82445	51.545	17.167	19.849
Senior Cohort (+65) (Male) %	42,9%	43,4%	43,4%	41,7%	43,1%	46,0%	42,8%	38,9%
Total Population	10.421.117	3.609.978	2.252.648	2.883.645	713376	469.983	238.794	252.693

Table 5 - Portugal Population Variation (2011 – 2021) (Own Elaboration)

Variations (2011 – 2021)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	-17.198	-6.700	-3.451	-4.404	-910	-1.157	-700	456
Births %	-18%	-21%	-19%	-14%	-15%	-22%	-25%	35%
Youth Cohort (< 19)	-253.884	-131.018	-60.609	-16.646	-14.098	-5.374	-11.768	-14.371
Youth Cohort (< 19) %	-12%	-17%	-14%	-3%	-10%	-6%	-19%	-24%
Adults (20-64 | Active Population)	-321.055	-136.571	-106.726	-23.915	-36.841	-1.276	-3.824	-11.902
Adults (20-64 | Active Population) %	-5%	-6%	-8%	-1%	-8%	0%	-2%	-7%
Senior Cohort (+65)	437.106	193.696	90.396	100.877	8.962	24.312	7.291	11.572
Senior Cohort (+65) %	22%	31%	17%	19%	5%	28%	22%	29%
Total Population	-137.833	-73.893	-76.939	60.316	-41.977	17.662	-8.301	-14.701
Total Population %	-1%	-2%	-3%	2%	-6%	4%	-3%	-5%

For 2031, four distinct scenarios were constructed. The different scenarios only change within the migration balance, assuming the same estimates regarding the others important factors for population projection, such as fertility, mortality and survival rates.

The scenario for 2031, without migration, provided insights based solely on natural demographic changes, births and deaths, during the period between 2021 and 2031. On this scenario, the Portuguese population in 2031 would be slightly over 10.2 million individuals, a decline of nearly 200.000 comparing to 2021. The young age cohort would constitute

approximately 17% of the population. On the contrary, the elderly population would witness a significant surge, comprising 30% of the populace in 2031, totaling over 3 million people. Meanwhile, the adult demographic group, without the migration influx, would experience a decline around 10%, translating to 500.000 individuals, thereby weakening Portugal's labor pool (Table 6 – Portugal Population in 2031 (No Migration); Table 7 – No Migration Portugal Population Variation (2021 – 2031)).

Table 6 - Portugal Population in 2031 (No Migration) (Own Elaboration)

2031 – No Migration	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	79.315	25.289	14.728	26.597	5.014	3.933	2.012	1.776
Youth Cohort (< 19)	1.674.366	539.378	331.437	543.316	107.985	82.264	42.632	37.880
Youth Cohort (< 19) %	17,0%	15,2%	15,4%	18,9%	16,1%	17,9%	17,9%	15,4%
Youth Cohort (Male)	859.129	276.838	175.224	278.723	55.335	42.173	21.938	19.338
Youth Cohort (Male) %	51,3%	51,3%	52,9%	51,3%	51,2%	51,3%	51,5%	51,1%
Adults (20-64 | Active Population)	5.554.885	1.938.864	1.151.378	1.600.138	357.036	246.771	141.180	139.618
Adults (20-64 | Active Population) %	56,5%	54,6%	53,6%	55,6%	53,2%	53,6%	59,3%	56,7%
Adults (20-64 | Active Population) (Male)	2.725.676	948.520	581.274	778.358	180.935	121.724	70.112	68.656
Adults (20-64 | Active Population) (Male) %	49,1%	48,9%	50,5%	48,6%	50,7%	49,3%	49,7%	49,2%
Senior Cohort (+65)	3.004.659	1.071.489	664.742	735.057	206.322	131.731	54.464	68.804
Senior Cohort (+65) %	30,5%	30,2%	31,0%	25,5%	30,7%	28,6%	22,9%	27,9%
Senior Cohort (+65) (Male)	1.255.960	455.331	273.856	301.554	89.541	58.888	24.101	27.503
Senior Cohort (+65) (Male) %	41,8%	42,5%	41,2%	41,0%	43,4%	44,7%	44,3%	40,0%
Total Population	9.838.676	3.549.731	2.147.557	2.878.511	671.342	460.765	238.275	246.302

Table 7 - No Migration Portugal Population Variation (2021 – 2031) (Own Elaboration)

Variations – No Migration (2021 – 2031)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	-480	464	-163	-126	-221	-186	-36	32
Births %	-1%	2%	-1%	0%	-4%	-5%	-2%	2%
Youth Cohort (< 19)	-212.352	-90.387	-45.297	-29.501	-16.010	-5.625	-6.402	-8.604
Youth Cohort (< 19) %	-11%	-14%	-12%	-5%	-13%	-6%	-13%	-19%
Adults (20-64 | Active Population)	-517.870	-214.763	-113.632	-81.028	-41.075	-23.213	-8.495	-15.564
Adults (20-64 | Active Population) %	-9%	-10%	-9%	-5%	-10%	-9%	-6%	-10%
Senior Cohort (+65)	543.015	244.903	53.838	105.395	15.052	19.621	14.379	17.777
Senior Cohort (+65) %	22%	30%	9%	17%	8%	18%	36%	35%
Total Population	-582.441	-60.247	-105.091	-5.134	-42.034	-9.218	-519	-6.391
Total Population %	-6%	-2%	-5%	0%	-6%	-2%	0%	-3%

The scenario with a low level of migration, assumed a migration balance reflecting the average of the previous 5 years, 2017 to 2021, around 50.000 annually. With this assumption, during the period from 2021 to 2031, Portugal will obtain approximately 500.000 residents by migration. Consequently, the population would increase by 280.000, reaching 10.7 million. Through a positive migration balance, the demographic adult group benefits the most, which

instead of experiencing a decrease of over 500.000, only sees a decline of 220.000 individuals. Although young age cohort still constitute a relatively low percentage of the total population, around 16%. The absolute number reduction between 2021 and 2031 at the young age group in this scenario would be roughly 150.000, comparing to the 210.000 projected in the 'without migration' scenario. The number of births would surpass 80.000 in 2031, contributing to the improvement of the young age demographic group (Table 8 – Portugal Population in 2031 (Low Migration); Table 9 – Low Migration Portugal Population Variation (2021 – 2031)).

Table 8 - Portugal Population in 2031 (Low Migration) (Own Elaboration)

2031 – Low Migration	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	82.010	25.924	15.535	27.264	5.277	4.229	2.006	1.824
Youth Cohort (< 19)	1.732.772	554.189	339.283	556.587	113.458	87.988	42.538	38.978
Youth Cohort (< 19) %	16,2%	15,1%	14,8%	18,7%	15,9%	17,4%	17,9%	15,3%
Youth Cohort (Male)	893.013	285.451	175.435	286.399	58.506	45.481	21.884	19.977
Youth Cohort (Male) %	51,5%	51,5%	51,7%	51,5%	51,6%	51,7%	51,4%	51,3%
Adults (20-64 | Active Population)	5.853.700	2.016.218	1.221.742	1.666.268	384.692	274.980	140.364	145.341
Adults (20-64 | Active Population) %	54,7%	54,9%	53,3%	55,8%	53,8%	54,4%	59,2%	56,9%
Adults (20-64 | Active Population) (Male)	2.904.779	994.885	613.881	818.005	197.511	138.632	69.623	72087
Adults (20-64 | Active Population) (Male) %	49,6%	49,3%	50,2%	49,1%	51,3%	50,4%	49,6%	49,6%
Senior Cohort (+65)	3.119.209	1.101.275	730.018	761.005	216.744	142.457	54.217	70.952
Senior Cohort (+65) %	29,1%	30,0%	31,9%	25,5%	30,3%	28,2%	22,9%	27,8%
Senior Cohort (+65) (Male)	1.323.359	472.887	324.445	317.209	95.696	65.231	23.858	28.769
Senior Cohort (+65) (Male) %	42,4%	42,9%	44,4%	41,7%	44,2%	45,8%	44,0%	40,5%
Total Population	10.705.681	3.671.682	2.291.043	2.983.860	714.894	505.425	237.119	255.271

Table 9 - Low Migration Portugal Population Variation (2021 – 2031) (Own Elaboration)

Variations – Low Migration (2021 - 2031)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	2.215	1.099	644	541	42	110	-42	80
Births %	3%	4%	4%	2%	1%	3%	-2%	5%
Youth Cohort (< 19)	-153.946	-75.576	-37.451	-16.230	-10.537	99	-6.496	-7.506
Youth Cohort (< 19) %	-8%	-12%	-10%	-3%	-8%	0%	-13%	-16%
Adults (20-64 | Active Population)	-219.055	-137.409	-43.268	-14.898	-13.419	4.996	-9.311	-9.841
Adults (20-64 | Active Population) %	-4%	-6%	-3%	-1%	-3%	2%	-6%	-6%
Senior Cohort (+65)	657.565	274.689	119.114	131.343	25.474	30.347	14.132	19.925
Senior Cohort (+65) %	27%	33%	19%	21%	13%	27%	35%	39%
Total Population	284.564	61.704	38.395	100.215	1.518	35.442	-1.675	2.578
Total Population %	3%	2%	2%	3%	0%	8%	-1%	1%

The scenario with a moderate level of migration assumes a growth rate of 5% annually, using the average of the years between 2017 and 2021 as the initial value for the calculations. With this hypothesis, Portugal will gain around 600.000 residents with migration, through the period of 2021 and 2031. The population, within this scenario, is projected to reach 10.8

million by 2031. The main difference compared to the low migration scenario described above is the minor decrease in the adult cohort population, with a reduction of only 100.000 individuals, whereas in the low migration scenario it had approached 150.000 (Table 10 – Portugal Population in 2031 (Moderate Migration); Table 11 – Moderate Migration Portugal Population Variation (2021 – 2031)).

Table 10 - Portugal Population in 2031 (Moderate Migration) (Own Elaboration)

2031 – Moderate Migration	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	82.442	26.026	15.665	27.370	5.319	4.276	2.007	1.831
Youth Cohort (< 19)	1.750.827	558.813	344.946	560.638	115.140	89.727	42.560	39.321
Youth Cohort (< 19) %	16,1%	15,1%	14,8%	18,6%	15,8%	17,3%	17,9%	15,2%
Youth Cohort (Male)	903.659	288.181	178.776	288.784	59.497	46.504	21.897	20.180
Youth Cohort (Male) %	51,6%	51,6%	51,8%	51,5%	51,7%	51,8%	51,4%	51,3%
Adults (20-64 | Active Population)	5.950.876	2.041.371	1.252.401	1.687.775	393.688	284.156	140.556	147.203
Adults (20-64 | Active Population) %	54,8%	55,0%	53,6%	55,9%	54,0%	54,7%	59,2%	57,0%
Adults (20-64 | Active Population) (Male)	2.963.055	1.009.969	632.269	830.904	202.906	144.135	69.738	73.203
Adults (20-64 | Active Population) (Male) %	49,8%	49,5%	50,5%	49,2%	51,5%	50,7%	49,6%	49,7%
Senior Cohort (+65)	3.155.181	1.110.607	738.436	768.941	220.045	145.840	54.219	71.634
Senior Cohort (+65) %	29,1%	29,9%	31,6%	25,5%	30,2%	28,1%	22,8%	27,7%
Senior Cohort (+65) (Male)	1.344.729	478.436	328.286	321.936	97.662	67.245	23.859	29.175
Senior Cohort (+65) (Male) %	42,6%	43,1%	44,5%	41,9%	44,4%	46,1%	44,0%	40,7%
Total Population	10.856.884	3.710.792	2.335.782	3.017.355	728.873	519.724	237.335	258.158

Table 11 - Moderate Migration Portugal Population Variation (2021 – 2031) (Own Elaboration)

Variations – Moderate Migration (2021 - 2031)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	2.647	1.201	774	647	84	157	-41	87
Births %	3%	5%	5%	2%	2%	4%	-2%	5%
Youth Cohort (< 19)	-135.891	-70.952	-31.788	-12.179	-8.855	1.838	-6.474	-7.163
Youth Cohort (< 19) %	-7%	-11%	-8%	-2%	-7%	2%	-13%	-15%
Adults (20-64 | Active Population)	-121.879	-112.256	-12.609	6.609	-4.423	14.172	-9.119	-7.979
Adults (20-64 | Active Population) %	-2%	-5%	-1%	0%	-1%	5%	-6%	-5%
Senior Cohort (+65)	693.537	284.021	127.532	139.279	28.775	33.730	14.134	20.607
Senior Cohort (+65) %	28%	34%	21%	22%	15%	30%	35%	40%
Total Population	435.767	100.814	83.134	133.710	15.497	49.741	-1.459	5.465
Total Population %	4%	3%	4%	5%	2%	11%	-1%	2%

The last scenario crafted through the cohort components method describes a scenario of high positive migration balance, featuring a 10% annual growth rate. In this scenario of migration balance, Portugal population stands to acquire approximately 800.000 individuals with migration, during the period between 2017 and 2031. As a result, the total population could ascend to 11 million, with an adult demographic group surpassing 6 million and maintaining

the same number of individuals as in 2021. Meanwhile, the youth cohort is poised to decrease by 100.000, while the elderly segment remains the age group with the most evident growth, constituting 30% of the population in 2031. The region of 'Norte' and 'Centro' face a more pronounced decline in the young cohort, complementary with the elderly population increased trend (Table 12 – Portugal Population in 2031 (High Migration); Table 13 – High Migration Portugal Population Variation (2021 – 2031)).

Table 12 - Portugal Population in 2031 (High Migration) (Own Elaboration)

2031 – High Migration	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	82.934	26.142	15.813	27.492	5.367	4.331	2.012	1.840
Youth Cohort (< 19)	1.775.032	565.022	352.544	566.059	117.393	92.051	42.611	39.781
Youth Cohort (< 19) %	16,0%	15,0%	14,7%	18,5%	15,7%	17,1%	17,9%	15,2%
Youth Cohort (Male)	917.970	291.857	183.272	291.984	60.828	47.875	21.925	20.452
Youth Cohort (Male) %	51,7%	51,7%	52,0%	51,6%	51,8%	52,0%	51,5%	51,4%
Adults (20-64 | Active Population)	6.082.202	2.075.364	1.293.834	1.716.841	405.845	296.559	140.999	149.720
Adults (20-64 | Active Population) %	55,0%	55,2%	53,9%	56,1%	54,3%	55,0%	59,3%	57,1%
Adults (20-64 | Active Population) (Male)	3.041.817	1.030.356	657.120	848.338	210.198	151.573	70.005	74.712
Adults (20-64 | Active Population) (Male) %	50,0%	49,6%	50,8%	49,4%	51,8%	51,1%	49,6%	49,9%
Senior Cohort (+65)	3.203.531	1.121.477	753.662	779.614	224.489	150.390	54.223	72.552
Senior Cohort (+65) %	29,0%	29,8%	31,4%	25,5%	30,0%	27,9%	22,8%	27,7%
Senior Cohort (+65) (Male)	1.373.495	484.898	337.369	328.300	100.310	69.958	23.861	29.721
Senior Cohort (+65) (Male) %	42,9%	43,2%	44,8%	42,1%	44,7%	46,5%	44,0%	41,0%
Total Population	11.060.765	3.761.863	2.400.040	3.062.513	747.727	539.000	237.833	262.053

Table 13 - High Migration Portugal Population Variation (2021 – 2031) (Own Elaboration)

Variations – High Migration (2021 - 2031)	Portugal	Norte	Centro	Lisboa	Alentejo	Algarve	Azores	Madeira
Births	3.139	1.317	922	769	132	212	-36	96
Births %	4%	5%	6%	3%	3%	5%	-2%	6%
Youth Cohort (< 19)	-111.686	-64.743	-24.190	-6.758	-6.602	4.162	-6.423	-6.703
Youth Cohort (< 19) %	-6%	-10%	-6%	-1%	-5%	5%	-13%	-14%
Adults (20-64 | Active Population)	9.447	-78.263	28.824	35.675	7.734	26.575	-8.676	-5.462
Adults (20-64 | Active Population) %	0%	-4%	2%	2%	2%	10%	-6%	-4%
Senior Cohort (+65)	741.887	294.891	142.758	149.952	33.219	38.280	14.138	21.525
Senior Cohort (+65) %	30%	36%	23%	24%	17%	34%	35%	42%
Total Population	639.648	151.885	147.392	178.868	34.351	69.017	-961	9.360
Total Population %	6%	4%	7%	6%	5%	15%	0%	4%

With these scenarios established, the project gained a deeper insight about how migration might address population aging problem in Portugal. Only in the scenario featuring a high positive migratory balance, it is possible to observe a mitigation of population aging, characterized by a stabilization in the number of adults within Portugal. This facilitates an immediate response to labor market demands and social security challenges, despite the

steady decline at the young age cohort combined with an increase in older group age. This triggers whether migration alone can effectively address the problem with the population aging for a long-term perspective. Additionally, factors such as fertility and mortality, that have not been tested in the calculations, appear to become significant once the method has been implemented, especially the fertility factor. Given the already high survival rates that exist in Western nations, like Portugal, it becomes clear that fertility politics may emerge as a pivotal factor along with the migration politics. Like the literature review indicates, Migration policies isolated may appears insufficient to reverse the trajectory of Portuguese population, since it fails to adequately address the needs of the young age group.

4.2. SLIDES, DASHBOARDS AND DATA ANALYSIS

This project segment represents the consummation of every project step, providing a series of slides and dashboards designed to provide a clear, visual, and comprehensive understanding of the aging process of the Portuguese population and the role of migration in addressing the demographic trend.

The cover of the slide deck, shown in Figure 2 – Cover Page, is presented in a straightforward design. It allows navigate to specific areas of interest by clicking on the various buttons included.

Figure 2 - Cover Page (Own Elaboration)

The first slide, “Resident Population” slide (Figure 3 – Resident Population), provides an analysis of the resident population in Portugal. It showcases the population’s evolution and transformation over the last century, its age distribution, and the geographical location, across five different years (2001, 2006, 2011, 2016, and 2021). The slide incorporates interactive features, enabling connections between several representations and deeper insights into the data trends.

In terms of the data, the slides highlight two important events, the shift in age group dynamics, young cohort through 30% in 2001 to 25% in 2021 and elderly cohort from 17% to 24% of total population, and the demographic shift from the interior regions to the coastal areas, mostly in the NUTS III regions of Lisbon, Porto, and Algarve.

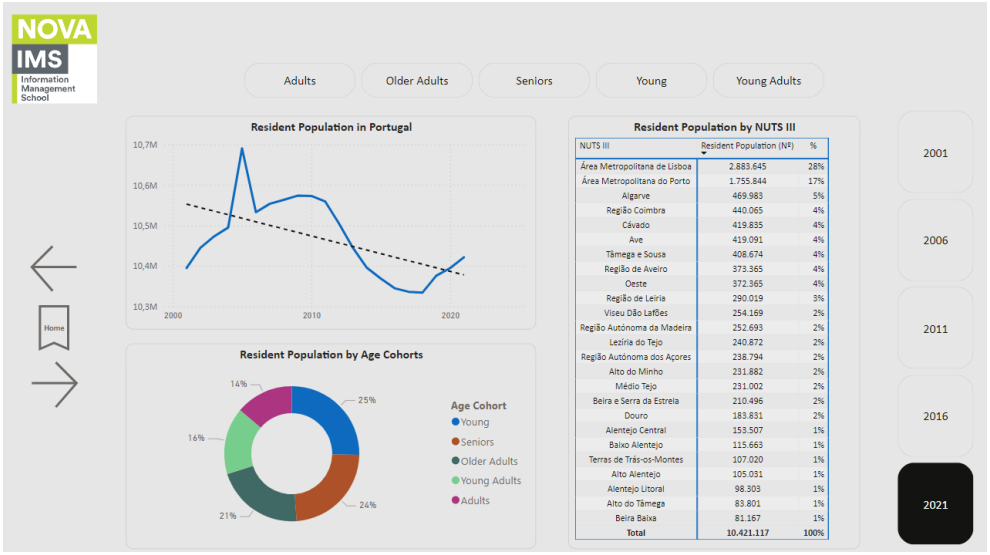
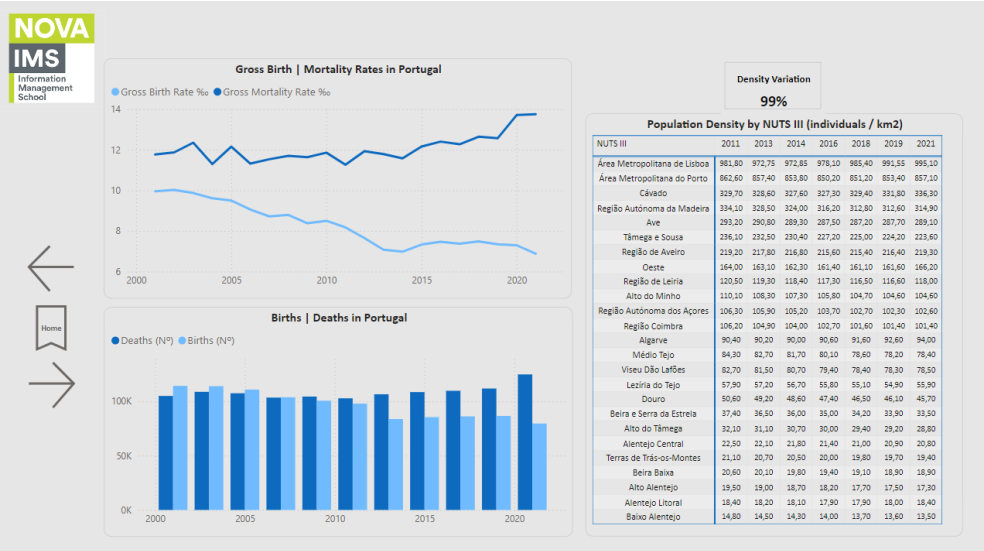


Figure 3 - Resident Population (Own Elaboration)

The second slide, Figure 4 – Resident Population II, continues to present data about the resident population in Portugal, with a specific focus on mortality and fertility trends in Portugal over the last decades. Additionally, it includes a table that further explores the evolution and changes in population density through NUTS III regions.

The data displayed on the slide reveal that births, deaths, fertility rates and mortality rates have intensified the problem around population aging in Portugal. Gross birth rates have consistently declined, while gross death rates have increased, both in absolute and percentage values. Finally, the table on the right indicates the population density values, highlighting the numbers of the metropolitan areas of Lisbon and Porto.

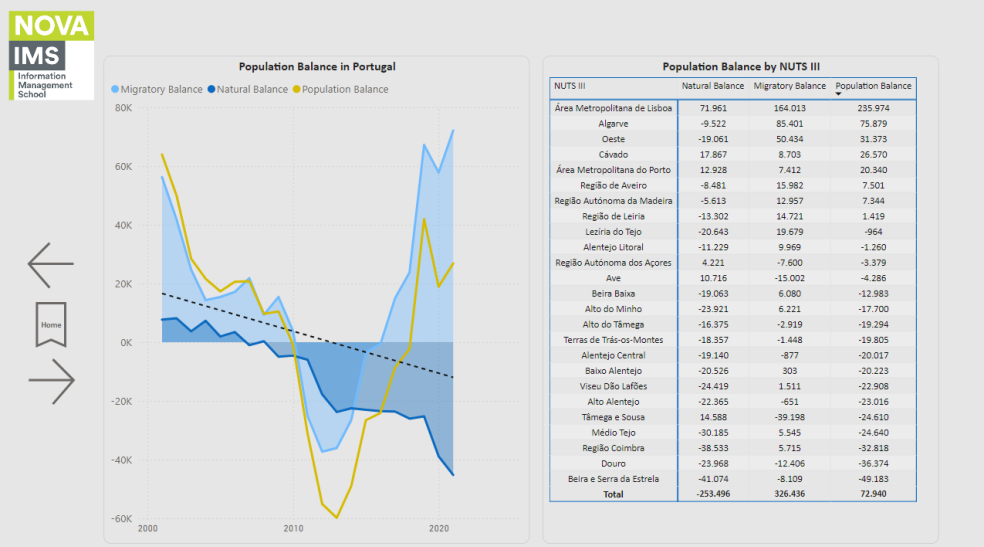


NUTS III	2011	2013	2014	2016	2018	2019	2021
Área Metropolitana de Lisboa	981,80	972,75	972,85	978,10	985,40	991,55	995,10
Área Metropolitana do Porto	862,60	857,40	853,80	850,20	851,20	853,40	857,10
Cávado	329,70	328,60	327,60	327,30	329,40	331,80	336,30
Região Autónoma da Madeira	334,10	328,50	324,00	316,20	312,80	312,60	314,90
Ave	293,20	290,80	289,30	287,50	287,20	287,70	289,10
Tâmega e Sousa	236,10	232,50	230,40	227,20	225,00	224,20	223,60
Região de Aveiro	219,20	217,80	216,80	215,60	215,40	216,40	219,30
Oeste	164,00	163,10	162,30	161,40	161,10	161,60	166,20
Região de Leiria	120,50	119,30	118,40	117,30	116,50	116,60	118,00
Alto do Minho	110,10	108,30	107,30	105,80	104,70	104,60	104,60
Região Autónoma dos Açores	106,30	105,90	105,20	103,70	102,70	102,30	102,60
Região Coimbra	106,20	104,90	104,00	102,70	101,60	101,40	101,40
Algarve	90,40	90,20	90,00	90,60	91,60	92,60	94,00
Médio Tejo	84,30	82,70	81,70	80,10	78,60	78,20	78,40
Viseu Dão Lafões	82,70	81,50	80,70	79,40	78,40	78,30	78,50
Lezíria do Tejo	57,90	57,20	56,70	55,80	55,10	54,90	55,90
Douro	50,60	49,20	48,60	47,40	46,50	46,10	45,70
Beira e Serra da Estrela	37,40	36,50	36,00	35,00	34,20	33,90	33,50
Alto do Tâmega	32,10	31,10	30,70	30,00	29,40	29,20	28,80
Alentejo Central	22,50	22,10	21,80	21,40	21,00	20,90	20,80
Terras de Trás-os-Montes	21,10	20,70	20,50	20,00	19,80	19,70	19,40
Beira Baixa	20,60	20,10	19,80	19,40	19,10	18,90	18,90
Alto Alentejo	19,50	19,00	18,70	18,20	17,70	17,50	17,30
Alentejo Litoral	18,40	18,20	18,10	17,90	17,90	18,00	18,40
Baixo Alentejo	14,80	14,50	14,30	14,00	13,70	13,60	13,50

Figure 4 - Resident Population II (Own Elaboration)

The following slide, about the population balance in Portugal (Figure 5 – Population Balance), clearly illustrates the evolution of Portugal's population balance and how the migration balance have contributed to the overall demographic trends.

It becomes evident that Portugal's population balance has been heavily influenced by migration trends. Between 2010 and 2016, negative migration balances had a significant adverse impact on the overall population balance. However, after 2016, consecutive positive migration balances contributed to the return of positive overall population balance growth. The trend has been most pronounced in the Lisboa and Algarve NUTS III regions.



NUTS III	Natural Balance	Migratory Balance	Population Balance
Área Metropolitana de Lisboa	71.961	164.013	235.974
Algarve	-9.522	85.401	75.879
Oeste	-19.061	50.434	31.373
Cávado	17.867	8.703	26.570
Área Metropolitana do Porto	12.928	7.412	20.340
Região de Aveiro	-8.481	15.982	7.501
Região Autónoma da Madeira	-5.613	12.957	7.344
Região de Leiria	-13.302	14.721	1.419
Lezíria do Tejo	-20.643	19.679	-964
Alentejo Litoral	-11.229	9.969	-1.260
Região Autónoma dos Açores	4.221	-7.600	-3.379
Ave	10.716	-15.002	-4.286
Beira Baixa	-19.063	6.080	-12.983
Alto do Minho	-23.921	6.221	-17.700
Alto do Tâmega	-16.375	-2.919	-19.294
Terras de Trás-os-Montes	-18.357	-1.448	-19.805
Alentejo Central	-19.140	-877	-20.017
Baixo Alentejo	-20.526	303	-20.223
Viseu Dão Lafões	-24.419	1.511	-22.908
Alto Alentejo	-22.365	-651	-23.016
Tâmega e Sousa	14.588	-39.198	-24.610
Médio Tejo	-30.185	5.545	-24.640
Região Coimbra	-38.533	5.715	-32.818
Douro	-23.968	-12.406	-36.374
Beira e Serra da Estrela	-41.074	-8.109	-49.183
Total	**-253.496**	**326.436**	**72.940**

Figure 5 - Population Balance (Own Elaboration)

In "Foreign Population" slide, Figure 6 – Foreign Population, the project presents detailed data on the foreign population living in Portugal. The slide highlights the trends about the foreign population over the years and their regions and countries of origin.

Between 2011 and 2021, the foreign population in Portugal increased by 60%. Since 2016, there has been a significant increase in the foreign population in Portugal, with official figures reaching nearly 700.000 individuals by 2021. The foreign population in Portugal remains closely tied to the country's historical connections, with the majority originating from the CPLP countries. In recent years, there has also been substantial growth in the number of residents from Asia. The foreign population is predominantly clustered in the metropolitan regions of Lisbon and Porto, with a few exceptions. In Algarve, there is a significant community from Western Europe, particularly from United Kingdom. Adding to that, a notable Asian community has established itself in the Alentejo Litoral NUTS III region.

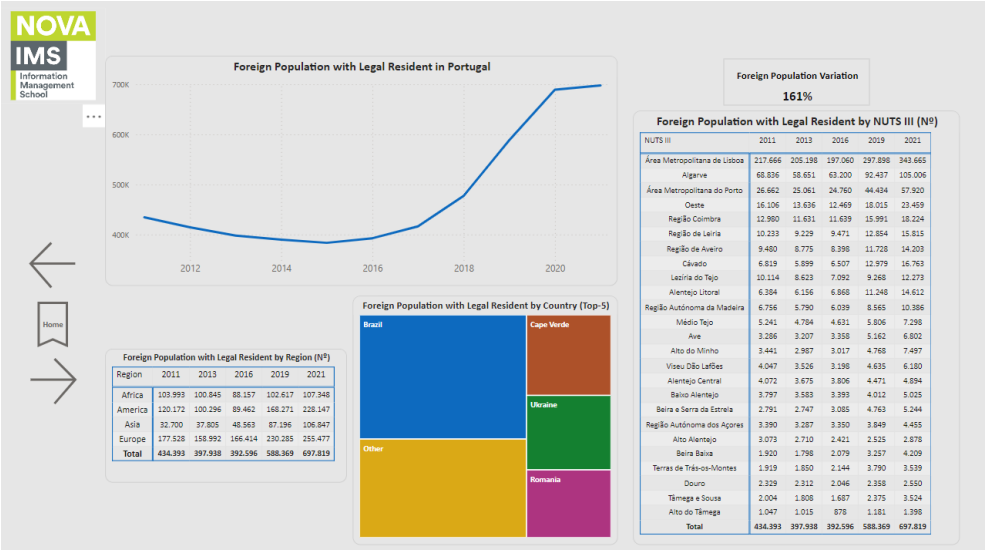


Figure 6 - Foreign Population (Own Elaboration)

The fifth slide (Figure 7 – Immigration Population) builds upon the information about immigration in Portugal. The slide supplies insights regarding the origins of the immigration population, their country of origin and the gender distribution among the immigration in Portugal.

The data shows a significant increase in the immigrant population since 2016, reaching nearly 700.000 persons by 2021. The main districts of settlement are large urban centers such as Lisbon, Faro, Setúbal, and Porto. In 2021, the immigrant population was primarily composed of individuals from the CPLP countries, with a notable cluster from Brazil. Gender distribution among immigrants is generally balanced, however this trend does not hold for immigrants from Asia, where 65% are male and only 35% are female.

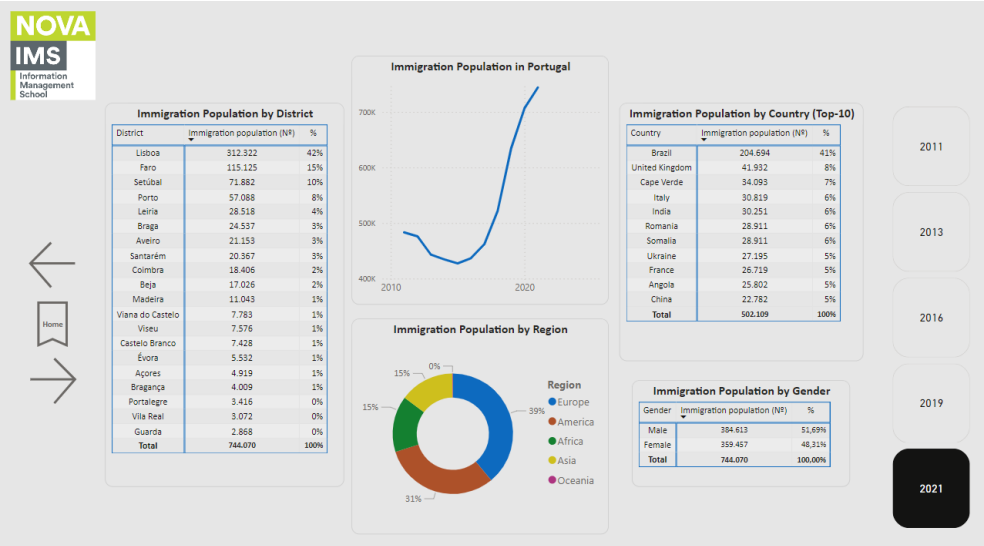


Figure 7 - Immigration Population (Own Elaboration)

The slide about emigration, Figure 8 – Emigration Population, was created to add a different layer of information inside the project. The purpose of the slide is to offer insights into the destinations and characteristics that could define Portuguese emigration, with the objective of facilitating interpretation between immigration and emigration data.

The data reveal that emigration reached its peak between 2011 and 2016. While there has been a decline in emigration in recent years, a substantial outflow of emigrants continues. This slide also highlights a shift in the educational profile of emigrants. Portuguese emigration, once characterized by a low-skilled workforce, has increasingly become more qualified. Nearly 50% of Portuguese emigrants hold a higher education degree in 2021, compared to just 30% in 2015.

Europe remains the most important destination for Portuguese emigrants, with United Kingdom, Luxembourg, Netherlands, Germany, France, and Switzerland being key countries in the Portuguese diaspora. Outside Europe, countries like Brazil, the United States, and Canada continue to play a significant role in the Portuguese emigrant community across the years.

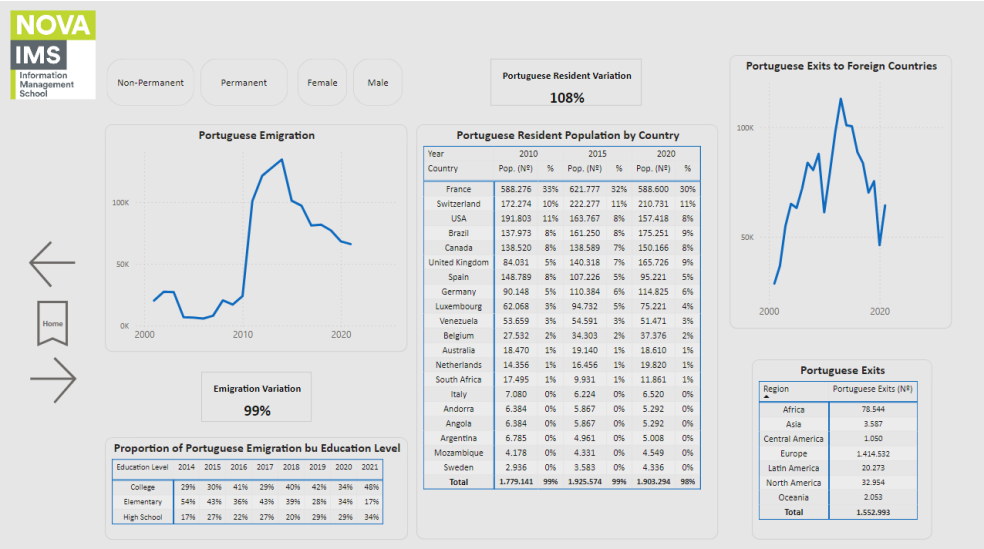


Figure 8 - Emigration Population (Own Elaboration)

The final slide, Figure 9 – Population Projection, was designed to visually present the results of the preceding population projection executed, using the cohort component method. The objective is to showcase the different population tendencies in Portugal below various migration scenarios.

The slide illustrates the variations in population projections based on the calculated migration scenarios, segmented by regions, NUTS II, and age groups. With this collection of slides, and specially the final slide, it becomes possible to better understand the role and significance of migration in addressing the challenges posed by the Portuguese demographic population characteristics. It becomes evident that Portugal's population, particularly its active population cohort, is heavily reliant on the inflow of migrants to stabilize its numbers, assuming factors such as fertility rates remain unchanged in the following years.

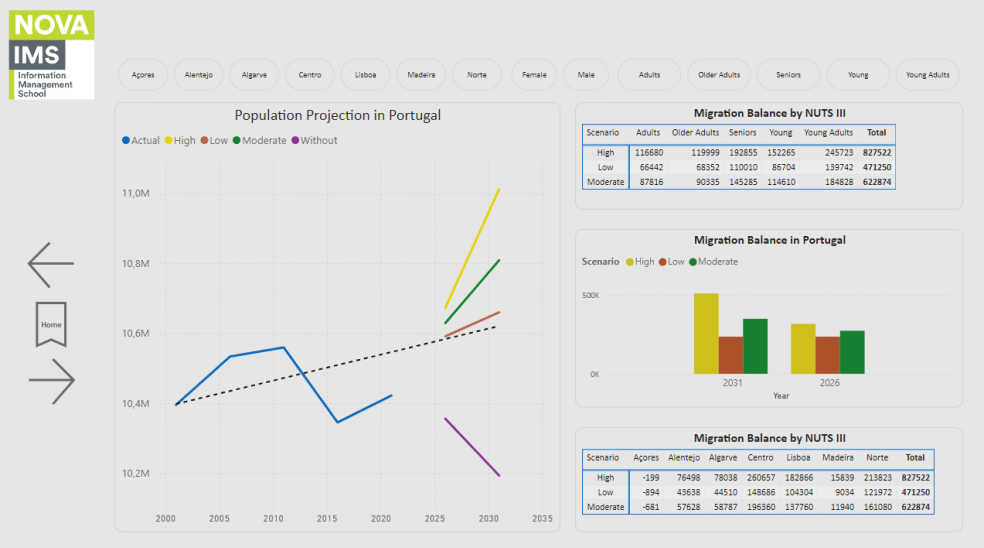


Figure 9 - Population Projection (Own Elaboration)

5. CONCLUSIONS, LIMITATIONS AND FUTURE WORKS

In the end of the project, it is essential to conduct an assessment to determine whether the objectives were achieved. This process involves an evaluation of the constructed artifact, identifying the limitations that appeared during its execution, and highlighting departments where possible improvements could be made in future artifacts and projects.

Overall, the project successfully addressed its defined objectives, demonstrating the path of Portuguese demographics in the 21st century and projecting future patterns through the execution of a population projection, using the cohort components method. The migration data presents enabled the establishment of correlations between the evolution of the Portuguese population and the migration patterns.

Combining the collected data and the calculated data from the population projection, the project created the possibility to understand the influence of migration in Portugal demography and potential effects that different migration scenarios might have in the following years. Along these lines, the artifact provided the foundation to address and comprehend the key aspects outlined in the project. The artifact displays several benefits that can offer to decision-makers.

- Enables the targeting and adjustment of socio-economic policies.
- Provides organizations and society with essential knowledge and with an important tool to plan and prepare future initiatives.
- Facilitates communication and awareness of the circumstances to institutions and society.

The layers of the project enabled the identification and understanding of several key conclusions, which also validated numerous statements pointed out in the literature review.

- Portugal has experienced an impressive increase in the ageing of its population, driven largely by low birth rates and mortality rates, and high life expectancy rates.
- Exponential increase in immigration to Portugal since 2019, contrasting extremely with the period between 2011 and 2016, which observed a significant exodus of individuals from the country.
- Immigration to Portugal is origin predominantly from CPLP and European countries, although in the last years, there has also been a noticeable rise in immigration to Portugal from Asian countries. This segment, on contrary of CPLP and European immigrants' group, could presents greater challenges for integration in society, as cultural differences can be substantial.

- Portuguese emigration has shifted from predominantly low-skilled and low-educated to a trend characterized by a high proportion of emigration with high levels of education and qualifications.
- Despite the extraordinarily high net migration rate of Portugal since 2019, the projections done indicate that only maintaining a high positive level of net migration it is possible to mitigate the population aging trend, assuming features such as birth rates and life expectancy rates remain consistent with recent years.

Despite the main objectives being completed, there is space to improve and expand the artifact to address additional gains. Certain limitations encountered during the project prevented it from being more complete and from addressing the situation under study in a broader and more holistic perspective. It is important to understand the limitations for future improvements.

- The inconsistency of certain indicators and data excluded the possibility to provide additional insights and to augment more positions around the situation addressed by the project.
- The population projection was development at the NUTS II level, parting Portugal into only eight regions, offering a broad overview of regional demographic trends. However, this option may neglect intra-regional discrepancies, ignoring some localized patterns.
- The lack of a more robust dataset encompassing socio-economic dimensions limited the analysis and a deeper understanding of the problem, as well as its externalities for society.

To enhance and elevate the quality of the artifact and consequently of the project, it is valuable to enhance the capabilities of the artifact. The construction of a more holistically project is dependent upon the incorporation of external factors data related to the main situation, specifically data about socio-economic aspects. For future initiatives, constructing upon this artifact and project's foundation, it would be imperative include a deeper socio-economic analysis about the population and especially about the migration population, ensuring a more informed response from decision-makers.

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