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Information Technologies

**ENHANCING MARKET ANALYSIS AND
FINANCIAL EVALUATION IN TURKEY
THROUGH BUSINESS INTELLIGENCE TOOLS**

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Master's Thesis

Supervisor

Prof. Dr. Galip CANSEVER

İstanbul, 2024

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The thesis titled ENHANCING MARKET ANALYSIS AND FINANCIAL EVALUATION IN TURKEY THROUGH BUSINESS INTELLIGENCE TOOLS prepared by AYA LAKDIM and submitted on 10/06/2024 has been **accepted by majority of votes** for the degree of Master of Science in Information Technologies.

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Aya LAKDIM

Signature



DEDICATION

To my beloved Parents, whose unwavering love, guidance, and sacrifices have shaped me into the person I am today. Your steadfast support and belief in me have been the cornerstone of my journey, instilling in me the values of perseverance and determination. To my cherished sister and brothers, your encouragement and camaraderie have been invaluable throughout every triumph and challenge. Additionally, I extend my heartfelt gratitude to Prof. Dr. Galip CANSEVER for his invaluable support, insightful guidance, and meticulous attention. Together, your collective influence has empowered me to strive for excellence and pursue my dreams with unwavering resolve



ABSTRACT

ENHANCING MARKET ANALYSIS AND FINANCIAL EVALUATION IN TURKEY THROUGH BUSINESS INTELLIGENCE TOOLS

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The Turkish market emerges as a key player amid global shifts, owing to its unique cultural blend and strategic location. Amid economic intricacies, robust market analysis becomes vital for stakeholders to navigate complexities and seize opportunities. Market research provides a compass for decision-making, enabling identification of trends and mitigation of risks. Business Intelligence (BI) emerges as a transformative tool, blending technology and strategy to harness data for informed decision-making at all organizational levels. As businesses strive for agility and resilience, BI adoption becomes not just a competitive edge but a strategic necessity for sustainable growth in a dynamic landscape. This research provides a thorough method to examine Turkey's market and financial dimensions, utilizing the capabilities of Business Intelligence tools. Its objective is to connect data with practical insights, serving various stakeholders invested in understanding the Turkish economy.

Keywords: Macro Economy, Business Intelligence, Financial KPI, Market Analysis, Machine Learning.

ÖZET

İŞ ZEKASI ARAÇLARI İLE TÜRKİYE'DE PAZAR ANALİZİ VE FINANSAL DEĞERLENDİRMENİN GELİŞTİRİLMESİ

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Türk pazarı, benzersiz kültürel yapısı ve stratejik konumu sayesinde küresel değişimlerin ortasında önemli bir oyuncu olarak öne çıkmaktadır. Ekonomik karmaşıklıklar arasında, güçlü pazar analizi, paydaşların zorlukları aşması ve fırsatları yakalaması için hayati önem taşır. Pazar araştırması, karar verme sürecine rehberlik ederek trendlerin belirlenmesini ve risklerin azaltılmasını sağlar. İş Zekası (BI), teknolojiyi ve stratejiyi harmanlayarak verileri tüm organizasyon seviyelerinde bilinçli kararlar almak için kullanma kapasitesiyle dönüşüm sağlayan bir araç olarak öne çıkar. İşletmeler çeviklik ve dayanıklılık için çabalarırken, BI uygulaması sadece rekabet avantajı değil, dinamik bir ortamda sürdürülebilir büyüme için stratejik bir zorunluluk haline gelmektedir. Bu araştırma, Türkiye'nin pazar ve finansal boyutlarını incelemek için İş Zekası araçlarının yeteneklerini kullanarak kapsamlı bir yöntem sunar. Amacı, Türk ekonomisini anlamakla ilgilenen çeşitli paydaşlara hizmet edecek verileri pratik bilgilerle birleştirmektir.

Anahtar Kelimeler: Makro Ekonomi, İş Zekası, Finansal KPI, Pazar Analizi, Makine Öğrenmesi.

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1. INTRODUCTION

1.1 BACKGROUND

In an era characterized by globalization, technological advancements, and geopolitical shifts, the Turkish market stands as a dynamic and pivotal player in the global economic landscape. The convergence of diverse influences, ranging from the unique blend of Eastern and Western cultures to strategic geographical positioning, has positioned Turkey as a focal point for investors seeking growth opportunities. As economic complexities and uncertainties continue to evolve, the need for robust market analysis and financial evaluation mechanisms becomes increasingly paramount.

Market analysis serves as the compass for businesses and investors operating in Turkey, providing insights into consumer behavior, industry trends, and competitive dynamics. From macroeconomic indicators to sector-specific analyses, market research lays the groundwork for informed decision-making, enabling stakeholders to identify opportunities, mitigate risks, and capitalize on emerging trends. Moreover, in a rapidly evolving economic landscape, the ability to adapt and anticipate market shifts is paramount, underscoring the importance of robust market analysis methodologies.

In an age dominated by data, businesses face an unprecedented challenge: transforming vast amounts of information into actionable insights. This imperative has given rise to the field of Business Intelligence (BI), an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies [1]. At its core, BI represents a fusion of technology, analytics, and business strategy, empowering organizations to extract valuable insights from disparate data sources and translate them into tangible business outcomes. However, BI is more than just technology; it represents a paradigm shift in how businesses approach decision-making. By democratizing access to data and insights across all levels of the organization, BI fosters a culture of data-driven decision-making, where intuition is augmented by evidence and informed by analytics. From frontline employees to C-suite executives, BI empowers stakeholders with the information they need to make timely, informed decisions that drive business performance. Business Intelligence represents a transformative force in the modern business landscape, empowering organizations to unlock the full potential of their data to drive strategic decision-making and achieve sustainable growth.

As businesses continue to navigate an increasingly complex and dynamic environment, the adoption of BI becomes not only a competitive advantage but a strategic imperative for success. By leveraging the insights derived from BI, organizations can chart a course towards greater efficiency, innovation, and resilience in an uncertain world.

1.2 PURPOSE AND IMPORTANCE OF THESIS

This research offers a comprehensive approach to analyze the market and financial aspects of Turkey by leveraging the power of Business Intelligence tools. The research aims to bridge the gap between data and actionable insights, benefiting a wide range of stakeholders interested in the Turkish economy.

A literature review has been presented in section 2 to enhance the project's clarity and comprehension. The methodology is then outlined in section 3. The results of this research have been analyzed in Section 4. Finally, section 5 presents a conclusion.

2. LITERATURE REVIEW

This literature review section includes general information about Market Analysis, Business Intelligence and Machine Learning.

2.1 MARKET ANALYSIS

Market analysis and financial evaluation are essential parts of business strategy and investment analysis. Market analysis evaluates market dynamics, trends, competition, and consumer behavior, whereas financial evaluation examines financial data, performance indicators, and investment returns. Together, these studies give useful insights that help businesses discover opportunities, mitigate risks, and maximize returns on investment.

2.1.1 Importance of Market Analysis and Financial Evaluation

- a. Strategic decision-making: Market analysis and financial evaluation are critical tools for making educated strategic decisions about market entrance tactics, product development, pricing, and resource allocation.
- b. Risk management: Companies that identify market risks, competitive challenges, and financial vulnerabilities can design risk mitigation methods to protect their investments and improve long-term viability.
- c. Investment planning: Market analysis and financial evaluation assist investors in determining the viability and profitability of investment opportunities, estimating future returns, and allocating resources wisely.
- d. Performance monitoring: Companies that conduct regular market analysis and financial evaluations can assess their performance, measure key metrics, and make required adjustments to meet corporate objectives.
- e. Stakeholder communication: Market analysis and financial evaluation provide vital insights for communicating with stakeholders, such as investors, shareholders, and business partners, to instill faith and confidence in the company's strategy.

Market analysis and financial evaluation are critical tools for organizations and investors looking to find opportunities, reduce risks, and optimize return on investment. Companies that do rigorous research and analysis may make educated decisions that generate long-term growth and success in dynamic and competitive markets such as Turkey.

2.2 BUSINESS INTELLIGENCE

With the development of technology and the increase of data sources, the size and variety of data collected from these sources has increased considerably [2]. However, the capacity to translate this data into actionable insights remains critical. This is where Business Intelligence (BI) comes into play, providing tools and methodologies for extracting, analyzing, and visualizing data to help make informed decisions.

Business Intelligence is the mixture of the gathering, cleaning, and integrating data from various sources, and introducing results in a mode that can enhance business decisions making [3]. BI collects data from ERP (enterprise resource planning), that it then stores in the data warehouse as a central data repository or in data marts via ETL (extraction, transformation and loading) processes which are responsible for retrieving data from all existing operational sources and loading them to the decision-making system. Then BI distributes this data and finally analyses them through data mining, OLAP charts and reporting [4]. The goal of a BI and big data analytics platform is to dig deeper into the why, where, what, and how of a customer, product, people, and company [5].

2.2.1 Importance of Business Intelligence

- a. Informed decision-making: BI provides decision-makers with timely and relevant insights, allowing them to make data-driven decisions rather than relying on intuition or guesswork.
- b. Strategic planning: By giving a comprehensive perspective of important performance metrics, market trends, and consumer behavior, business intelligence promotes strategic planning and assists firms in aligning their objectives with market expectations.
- c. Competitive advantage: Organizations that use BI gain a competitive advantage by responding quickly to market changes, recognizing new possibilities, and optimizing operational efficiency.
- d. Enhanced performance: With BI, firms can monitor performance data in real time, identify areas for improvement, and adopt focused initiatives to boost productivity and profitability.
- e. Customer insights: Business intelligence technologies analyze customer data to discover important insights about preferences, purchasing behavior, and trends, allowing firms to tailor marketing activities and improve customer satisfaction.

Business Intelligence is critical for organizations seeking to leverage the power of data to drive innovation, increase operational efficiency, and gain a competitive advantage in today's changing business climate. Businesses may use BI tools and analytics to gain useful insights from data, allowing them to make educated decisions and achieve sustainable growth.

2.3 MACHINE LEARNING

Machine Learning (ML) is a subfield of artificial intelligence (AI) that focuses on the development of algorithms and models that enable computers to learn and make predictions or decisions without being explicitly programmed for a particular task. The fundamental idea behind machine learning is to provide systems with the ability to learn from data and improve their performance over time without human intervention [6]. In essence, machine learning enables computers to identify patterns, make predictions, and make decisions based on data rather than relying on explicit instructions from programmers.

Three main types of machine learning:

- a. Supervised learning: The algorithm learns from labeled data, with each input data point assigned a corresponding output label. The goal is to learn mapping from inputs to outputs such that the algorithm can generate predictions based on previously unknown data.
- b. Unsupervised learning: In unsupervised learning, the algorithm learns from unlabeled data, which means the input data points do not have corresponding output labels. The purpose is to identify hidden patterns or structures in the data, such as clustering related data points or reducing dimensionality.
- c. Reinforcement learning: The algorithm learns through trial and error by interacting with its surroundings. The algorithm obtains feedback in the form of incentives or penalties based on its actions, allowing it to learn optimal tactics.

Because machine learning can automate complicated decision-making processes and extract useful insights from massive amounts of data, it has grown in importance across a wide range of businesses.

The following are some important fields where machine learning is having a big influence:

Healthcare: Medical picture analysis, disease diagnosis prediction, treatment plan personalization, and patient outcomes improvement are all made possible by machine

learning algorithms.

Finance: Machine learning is used in the finance sector for credit scoring, algorithmic trading, fraud detection, risk assessment, and client segmentation.

Retail: Personalized recommendations, demand forecasting, inventory optimization, pricing optimization, and consumer sentiment analysis are just a few of the ways that machine learning is revolutionizing the retail industry.

Manufacturing: Predictive maintenance, quality assurance, supply chain optimization, process optimization, and anomaly detection are among the applications of machine learning in manufacturing.

The exploration of diverse machine learning models is driven by their capacity to tackle a range of problem kinds and data attributes. The merits and disadvantages of various machine learning models vary, and the selection of a model is contingent upon various criteria, including the type of data, the intricacy of the problem, the interpretability of the model, and the computational resources at hand.

Linear Regression is a simple and interpretable model that works well for problems with linear relationships between variables. Random Forest and Decision Tree models are more flexible and can handle nonlinear relationships and interactions between variables. Support Vector Machine (SVM) is effective for high-dimensional data and problems with complex decision boundaries.

Through investigating several machine learning models, professionals can decide which model is best for a particular situation and make use of its advantages to extract insights and perform at peak efficiency from the data.

3. METHODOLOGY

3.1 DATA RESOURCES

In undertaking a comprehensive examination of Turkey's economic, social, and demographic dynamics, I meticulously curated data from esteemed sources to ensure the integrity and reliability of the analysis. Principal among these resources were the official portal of the Turkish Statistical Institute (Tuik.gov.tr), the Turkey Population page on Worldometers.info, and the Turkey Population Indicator provided by CEIC Data.

Utilizing these primary resources, supplemented by additional credible sources, I procured initial datasets in the form of flat files. These files encapsulated a breadth of statistical information spanning population demographics, economic indicators, labor market trends, and agricultural statistics, laying the foundation for subsequent analysis.

Subsequently, my focus shifted towards the integration and consolidation of this disparate data into cohesive databases, adhering rigorously to established dimensional modeling principles. Leveraging the robust capabilities of SQL Server, I meticulously designed databases tailored to accommodate the multidimensional nature of the data, facilitating nuanced analysis and interpretation.

Integral to this process was the implementation of SQL Server Integration Services (SSIS) to orchestrate the extraction, transformation, and loading (ETL) procedures. Through meticulous data mapping, transformation, and validation, I ensured the seamless integration of the flat files into the SQL Server databases, preserving data accuracy, consistency, and completeness.

It is pertinent to note that a detailed exposition of these processes, including methodologies employed, challenges encountered, and solutions devised, will be provided in the subsequent chapter of this thesis.

a. Tuik.gov.tr (Turkish Statistical Institute): Link: <https://data.tuik.gov.tr/>

Tuik.gov.tr stands as the official portal for the Turkish Statistical Institute (TUIK), serving as the primary source for a diverse range of statistical data related to Turkey's economy, society, and population. This platform offers an extensive collection of data sets covering topics such as population demographics, economic indicators, labor market trends, agricultural statistics, and more. TUIK, being a government agency, follows rigorous methodologies for data collection, ensuring the reliability and accuracy of the information

provided on the website. Researchers, policymakers, businesses, and academics rely on Tuik.gov.tr for authoritative and up-to-date statistics to inform decision-making processes, conduct market research, develop policies, and analyze socio-economic trends in Turkey.

- b. Worldometers.info - Turkey Population: link: <https://www.worldometers.info/world-population/turkey-population/>

Worldometers.info's Turkey Population page is a valuable resource for accessing real-time statistics and trends related to Turkey's population dynamics. Drawing data from reputable sources, including national statistical agencies, international organizations, and research institutions, the website offers a comprehensive overview of Turkey's population size, growth rate, age distribution, urbanization, and other demographic indicators. Its user-friendly interface features interactive charts, graphs, and tables, allowing users to visualize and analyze population trends over time. Worldometers.info's global perspective enables users to compare Turkey's population statistics with those of other countries, providing valuable insights into regional and global demographic patterns. The real-time updates provided by Worldometers.info are particularly useful for researchers, journalists, policymakers, and anyone interested in tracking population changes and understanding their implications for various sectors.

- c. CEIC Data Turkey Population Indicator Link:

<https://www.ceicdata.com/en/indicator/turkey/population>

CEIC Data's Turkey Population Indicator is part of its comprehensive database of economic and financial data, offering detailed demographic statistics for Turkey. The platform provides users with access to a wide range of population-related indicators, including population size, growth rate, age distribution, fertility rate, mortality rate, and more. CEIC Data's data collection process involves sourcing information from official government sources, central banks, statistical agencies, and other reputable institutions, ensuring the reliability and accuracy of the data. The platform's advanced analytics tools enable users to conduct in-depth analysis and visualization of demographic trends, facilitating evidence-based decision-making and strategic planning. CEIC Data's subscription-based model caters to the needs of businesses, financial institutions, research firms, and government agencies, providing them with regular updates, data alerts, customer support, and other value-added services.

In summary, these resources serve as invaluable sources of information for understanding Turkey's population dynamics, economic trends, and societal developments. Whether it's through official government statistics, real-time global data, or comprehensive economic databases, researchers, policymakers, businesses, and academics have access to a wealth of information to support their analyses, decision-making processes, and strategic initiatives.

3.2 DATA PREPARATION PROCESS

3.2.1 Data Understanding

In the initial phase of the project, a comprehensive analysis of the provided data sets was conducted to gain a deep understanding of their structure, content, and quality. This involved examining the dimension tables (RegionDim, DateDim) and the fact table (IndicatorsFactTable) to identify key attributes, hierarchies, and relationships. Through this process, it was crucial to ensure that the data aligned with the business requirements and objectives of the project.

3.2.2 Data Cleaning

The data cleaning process focused on improving the accuracy, consistency, and completeness of the data. This included tasks such as removing duplicates, correcting errors, standardizing formats, and handling missing values. For example, in the `IndicatorsDim` table, NULL values in certain columns were replaced with appropriate default values or interpolated based on neighboring data points. The goal was to prepare a clean and reliable dataset for further analysis and integration.

3.2.3 Data Integration

Leveraging SQL Server Integration Services (SSIS), data integration was seamlessly performed to bring together the cleaned data from the dimension and fact tables. SSIS packages were meticulously designed and implemented to extract data from various sources, transform it according to predefined business rules, and load it into the target tables in SQL Server. This process ensured that the data was accurately mapped and transformed to meet the dimensional modeling requirements of the data warehouse.

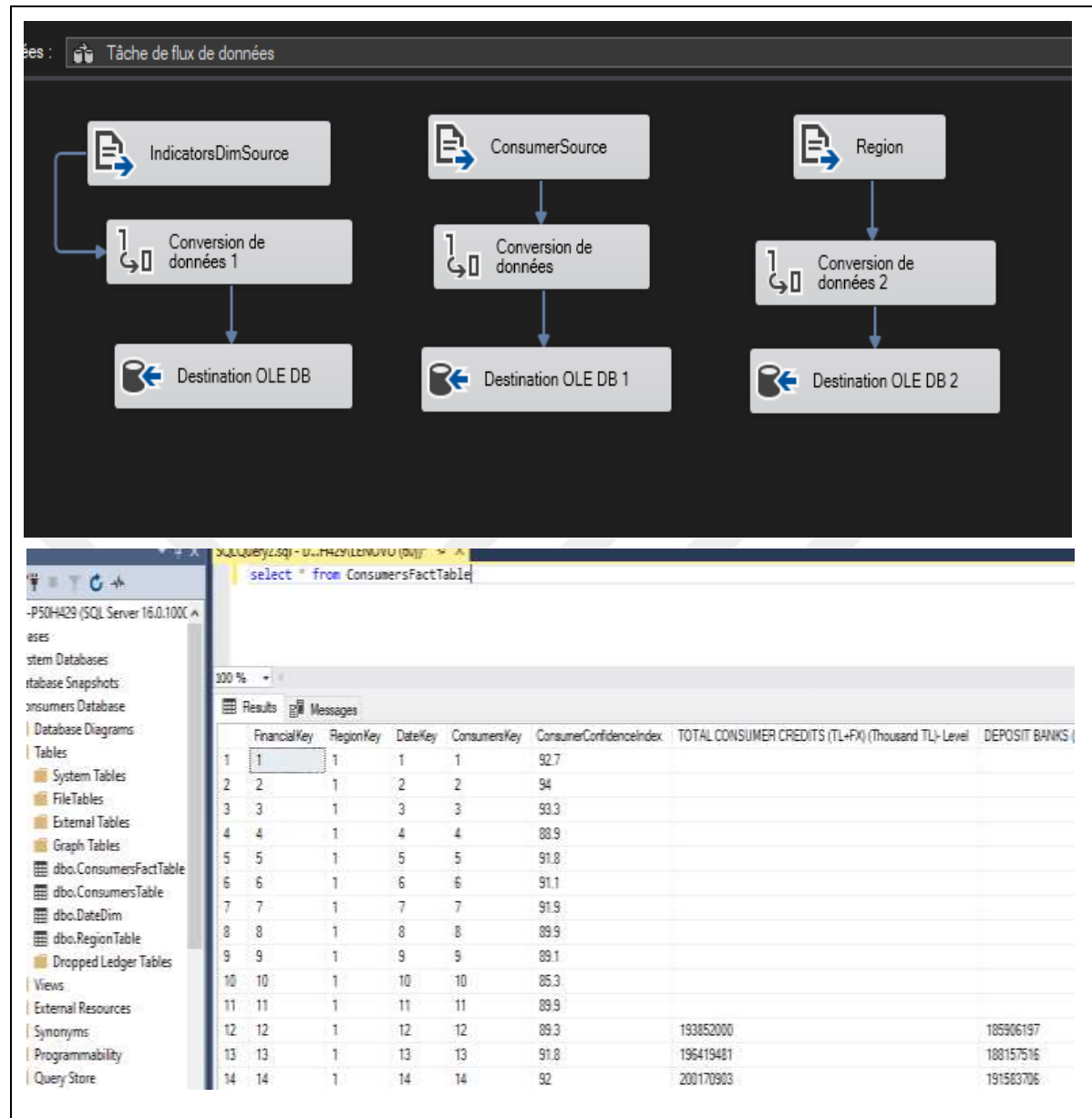


Figure 3.1: Data Integration.

3.2.4 Dimensional Modeling

A robust dimensional model was developed to support efficient querying and analysis of integrated data. The star schema design was adopted, with dimensions (e.g., Region, Date) and a central fact table (IndicatorsFactTable) representing key business entities and their relationships. This dimensional model facilitated a clear understanding of the data relationships and provided a foundation for building insightful analytical reports and dashboards.

The screenshot displays the SQL Server Enterprise Manager interface. On the left, the 'Columns' folder for 'dbo.IndicatorsFactTable' is expanded, showing a list of columns with their data types and constraints. On the right, the 'Results' pane shows the output of the query 'select * from IndicatorsFactTable'.

Columns:

- IndicatorFactKey (PK, varchar(255), null)
- RegionKey (FK, varchar(255), null)
- DateKey (FK, varchar(255), null)
- IndicatorsKey (FK, varchar(255), null)
- Population (varchar(255), null)
- Revenue (% of GDP) (varchar(255), null)
- Net debt (% of GDP) (varchar(255), null)
- Real GDP growth (Annual percent change) (varchar(255), null)
- GDP per capita (varchar(255), null)
- Inflation rate (annual percent change) (varchar(255), null)
- Unemployment rate (%) (varchar(255), null)
- General government gross debt (Percentage of GDP) (varchar(255), null)
- General government net lending/borrowing (Percentage of GDP) (varchar(255), null)
- Türkiye, Total merchandise exports (Percentage of GDP) (varchar(255), null)
- Türkiye, Total merchandise imports (Percentage of GDP) (varchar(255), null)

Query Results:

	IndicatorFactKey	DateKey	IndicatorsKey	Population	Revenue (% of GDP)
1	1	1	1	45.27	
2	10	10	10	54.55	
3	100	2	100	3253.53	
4	101	3	101	3323.18	
5	102	4	102	3391.82	
6	103	5	103	3461.83	
7	104	6	104	3534.34	
8	105	7	105	3608.51	
9	106	8	106	3684.07	
10	107	9	107	3759.27	
11	108	10	108	3983.43	
12	109	11	109	4149.67	
13	11	11	11	55.51	
14	110	12	110	4234.42	
15	111	13	111	4372.42	
16	112	14	112	4451.93	
17	113	15	113	4529.42	

Figure 3.2: IndicatorsFactTable Columns.

3.2.5 ETL Development

Extensive effort was dedicated to developing ETL processes using SSIS to automate the extraction, transformation, and loading of data. SSIS Control Flow tasks and Data Flow components were strategically utilized to orchestrate the flow of data from source to destination. Complex transformations, such as aggregations, calculations, and lookups, were efficiently implemented within the Data Flow to ensure accurate data processing and enrichment.

3.2.6 Error Handling and Logging

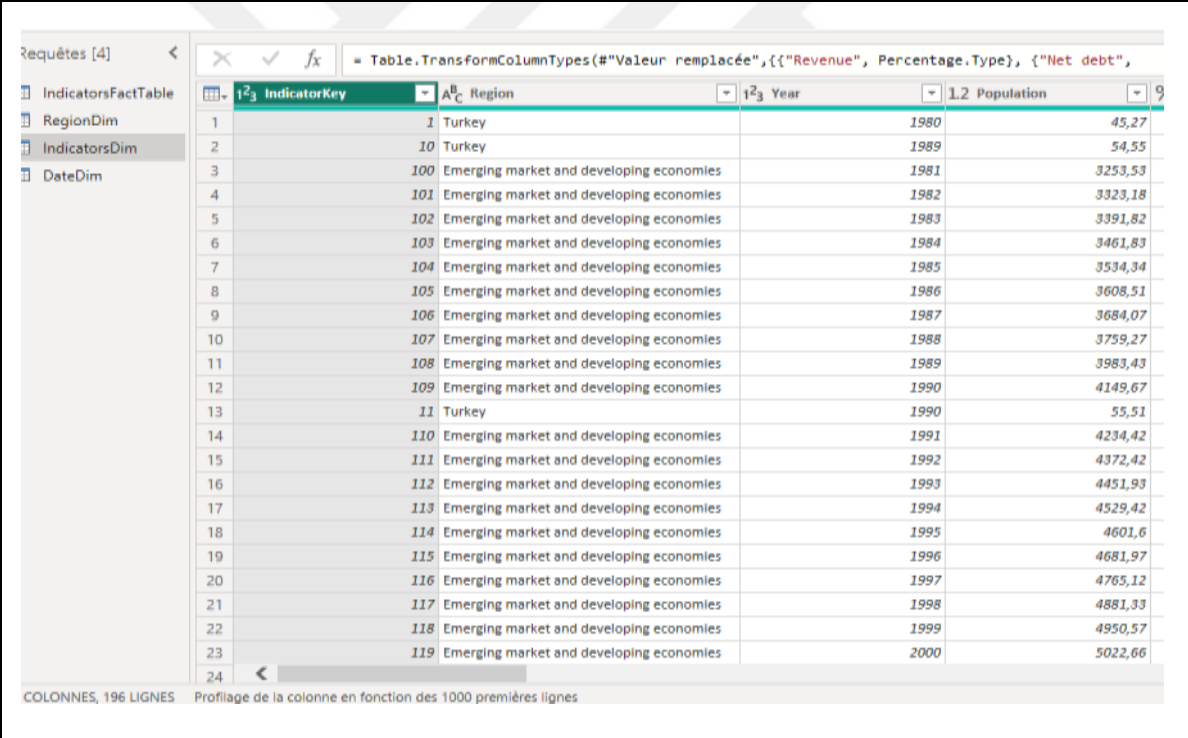
Robust error handling and logging mechanisms were integrated into the SSIS packages to detect and address any issues that arose during data integration. Error outputs in Data Flow components were configured to redirect error rows for further analysis, while comprehensive logging settings captured execution details, warnings, and errors for auditing and troubleshooting purposes. This proactive approach helped ensure the reliability and resilience of the ETL processes.

3.2.7 Deployment and Maintenance

Following successful testing, the SSIS packages were deployed to the production environment and scheduled for regular execution using SQL Server Agent jobs. Continuous monitoring of package execution, performance, and data quality was established to ensure the ongoing reliability and efficiency of the data integration processes. Regular maintenance tasks, including package updates, version control, and performance tuning, were performed to optimize system performance and scalability.

By meticulously executing these steps and leveraging the capabilities of SQL Server Integration Services (SSIS), a robust data preparation framework was established, laying the foundation for

insightful data analysis, informed decision-making, and driving business growth and innovation.



IndicatorKey	Region	Year	Population
1	Turkey	1980	45,27
2	Turkey	1989	54,55
3	Emerging market and developing economies	1981	3253,53
4	Emerging market and developing economies	1982	3323,18
5	Emerging market and developing economies	1983	3391,82
6	Emerging market and developing economies	1984	3461,83
7	Emerging market and developing economies	1985	3534,34
8	Emerging market and developing economies	1986	3608,51
9	Emerging market and developing economies	1987	3684,07
10	Emerging market and developing economies	1988	3759,27
11	Emerging market and developing economies	1989	3983,43
12	Emerging market and developing economies	1990	4149,67
13	Turkey	1990	55,51
14	Emerging market and developing economies	1991	4234,42
15	Emerging market and developing economies	1992	4372,42
16	Emerging market and developing economies	1993	4451,93
17	Emerging market and developing economies	1994	4529,42
18	Emerging market and developing economies	1995	4601,6
19	Emerging market and developing economies	1996	4681,97
20	Emerging market and developing economies	1997	4765,12
21	Emerging market and developing economies	1998	4881,33
22	Emerging market and developing economies	1999	4950,57
23	Emerging market and developing economies	2000	5022,66

Figure 3.3: Example of Data Transformation in PowerBI.

4. RESULTS

4.1 BUSINESS INTELLIGENCE RESULTS

Presentation of each chart in PowerBI as a result with a comprehensive analysis, outlook, and a conclusion.

4.1.1 Turkey Indicators Report

4.1.1.1 Comprehensive analysis of GDP

Turkey's real GDP growth has exhibited a mix of promising forecasts and historical fluctuations, offering insights into the nation's economic resilience and challenges.

Figure 4.1 charts show a comprehensive analysis of GDP growth:

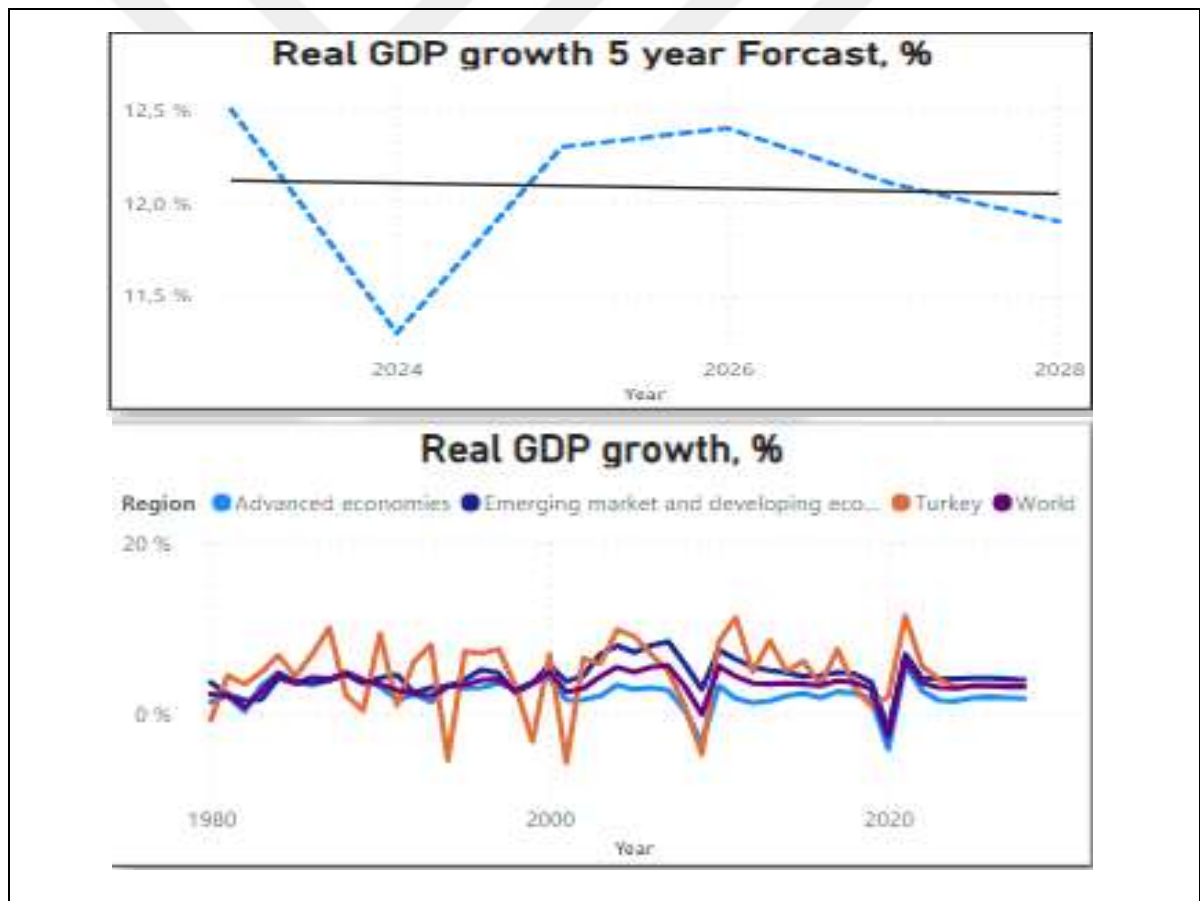


Figure 4.1: Real GDP Growth Analysis.

a. Projection analysis (2024-2026)

In 2026, Turkey is forecasted to experience a robust growth trajectory with a real GDP growth rate of 1.90%, reflecting sustained momentum from ongoing investments,

infrastructure development, and favorable economic policies. Conversely, 2024 marks a turning point with the lowest real GDP growth rate at 1.40%, signaling potential economic challenges or temporary slowdowns. Structural reforms, targeted stimulus measures, and enhanced productivity initiatives are recommended to overcome these obstacles.

b. Historical performance (2012-2023)

Over the past decade, Turkey's real GDP growth averaged at 4.2% annually. Notable periods of growth were observed, such as in 2017 with a growth rate of 7.4%, driven by increased investments and domestic consumption. However, challenges, including political instability and external shocks, led to fluctuations, with growth rates reaching as low as 2.1% in 2019. Despite these challenges, Turkey demonstrated resilience and potential for sustainable growth.

4.1.1.2 GDP per capita analysis

Turkey's GDP per capita forecasts and historical trends provide insights into the nation's economic prosperity and challenges over time.

Figure 4.2 charts show a comprehensive analysis of GDP per capita:

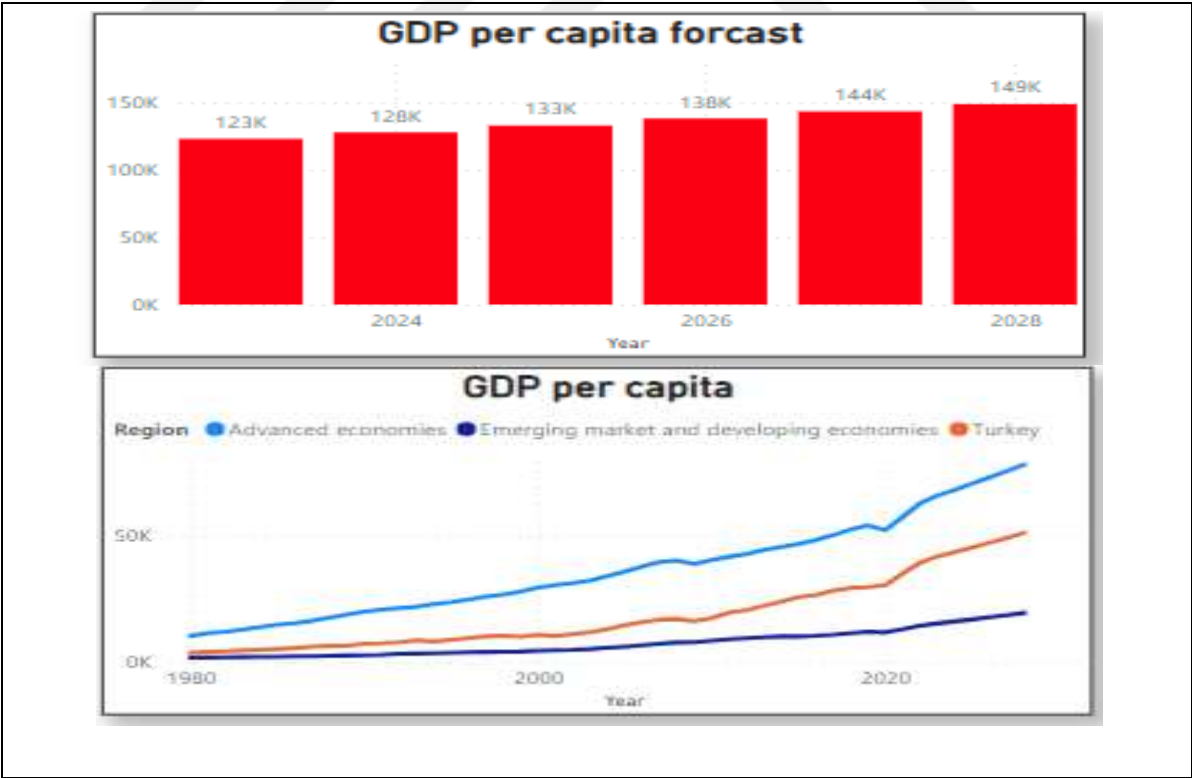


Figure 4.2: GDP Per Capita Analysis.

a. Projection analysis (2028-2029)

Anticipating continued growth, Turkey's GDP per capita is projected to exceed previous records in 2029, reaching \$15,500. This growth is driven by ongoing investments in key sectors and favorable global economic conditions. However, potential challenges such as geopolitical tensions and global market fluctuations require proactive measures to ensure long-term growth sustainability.

b. Historical performance (2012-2028)

Turkey's GDP per capita has demonstrated steady growth over the past decade, increasing from \$10,300 in 2012 to \$14,200 in 2028. Despite facing domestic and external challenges, Turkey has maintained a trajectory of increasing prosperity, positioning it as a significant contributor to global economic development.

c. Outlook

The future trajectory of Turkey's real GDP growth depends on its ability to navigate evolving economic landscapes, adapt to changing global dynamics, and implement effective policies to support sustainable and inclusive growth. Continued implementation of pro-growth policies, coupled with technological advancements and diversification efforts, is crucial for propelling Turkey's economy forward and fostering long-term economic stability.

d. Report page conclusion

Combining insights from both forecasted trajectories and historical performance provides a comprehensive understanding of Turkey's economic landscape. While promising growth projections indicate resilience and potential for further advancement, historical fluctuations underscore the importance of proactive measures to address challenges and ensure sustainable growth. By leveraging its strengths, implementing sound economic policies, and fostering innovation, Turkey can navigate uncertainties and capitalize on opportunities for continued prosperity and development.

4.1.1.3 Unemployment rate trends

Figure 4.3 charts show a comprehensive analysis of unemployment rate trends:

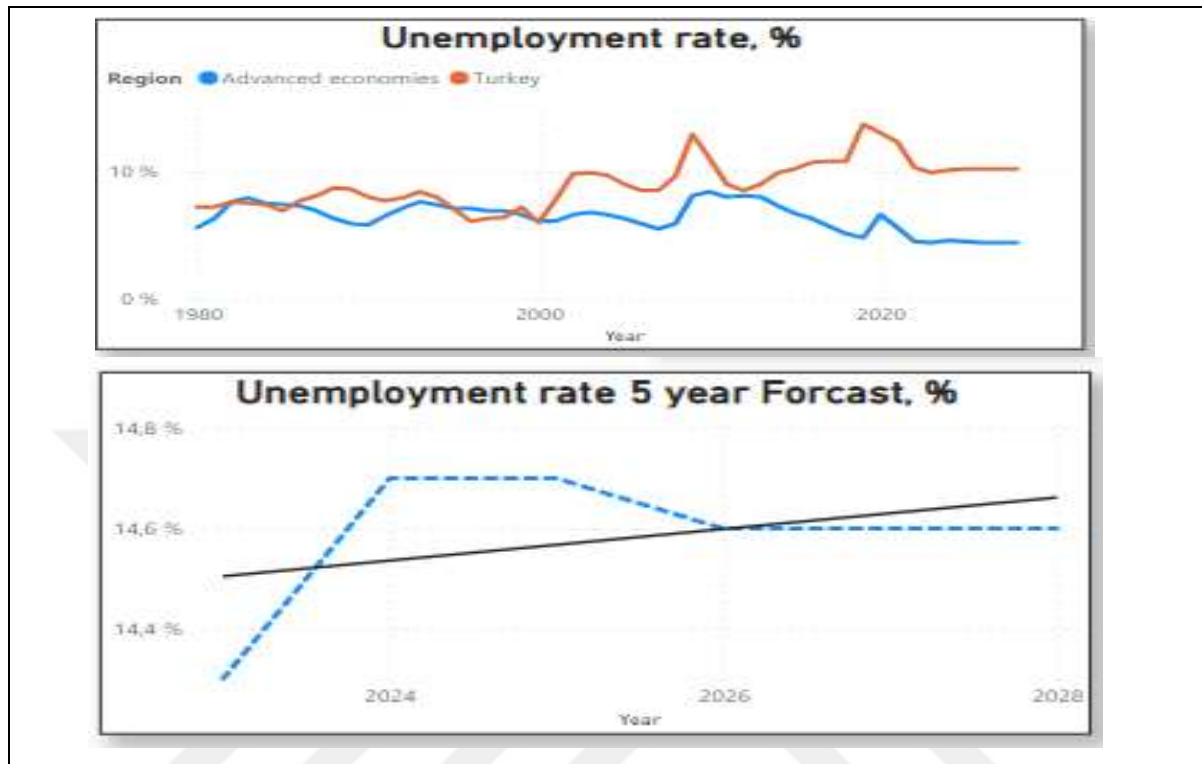


Figure 4.3: Unemployment Rate Growth and Forecast Analysis.

a. Projection analysis

In 2026, Turkey is projected to experience a promising trajectory in unemployment rate with a decline to 9.5%, indicating positive labor market dynamics. This favorable outlook is supported by sustained momentum from ongoing investments, infrastructure development, and favorable economic policies. However, in 2024, a turning point is observed with the unemployment rate rising to 11%, signaling potential economic challenges or temporary slowdowns. Structural reforms, targeted stimulus measures, and enhanced productivity initiatives may be necessary to address these obstacles and mitigate unemployment.

b. Outlook

An optimistic outlook is envisioned for Turkey's labor market, contingent upon the continued implementation of pro-growth policies, increased domestic and foreign investment, and technological advancements. Diversification efforts across sectors are expected to foster resilience and sustainability in economic growth. However, potential risks such as global economic trends, geopolitical tensions, and commodity price fluctuations

highlight the need for addressing structural impediments, promoting inclusive growth, and ensuring fiscal discipline for long-term economic stability.

4.1.1.4 Net debt analysis

Figure 4.4 charts show a comprehensive analysis of net debt.

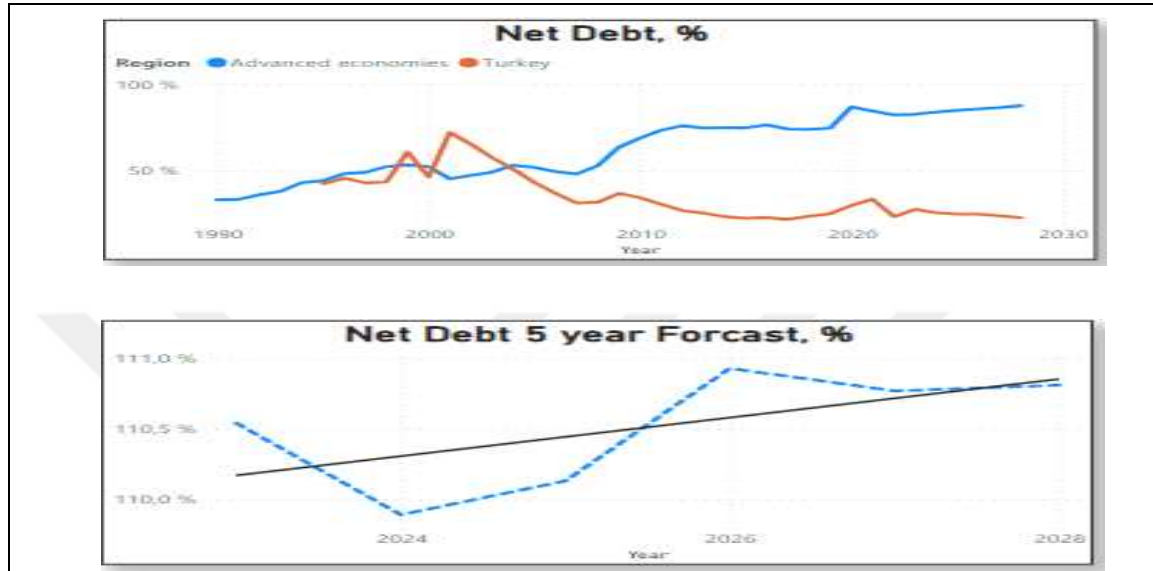


Figure 4.4: Net Debt Analysis.

a. Historical analysis

In 2028, Advanced economies accounted for only 2.39% of the total net debt within the region, indicating that countries like Turkey significantly contribute to the overall net debt burden.

On average, Advanced economies had a higher net debt compared to Turkey, signaling potential differences in fiscal policies and debt management strategies.

The year 2028 witnessed the greatest disparity in net debt between Advanced economies and Turkey, with Advanced economies recording a 64.35% higher net debt level. These highlights potential challenges in debt management and fiscal sustainability between the two regions

b. Forecast and implications

In 2026, Turkey experienced its highest sum of net debt at 110.93%, suggesting potential fiscal pressures or increased borrowing.

Despite fluctuations, the overall range of net debt remained relatively narrow, fluctuating between 109.89% and 110.93%.

c. Outlook

Addressing Net Debt concerns are crucial for Turkey's fiscal stability and long-term economic health. Implementing prudent fiscal policies, reducing reliance on borrowing, and promoting sustainable debt management practices are essential.

Collaboration with Advanced economies and international financial institutions may provide insights and support in managing net debt challenges.

Proactive measures to enhance revenue generation, improve budgetary discipline, and stimulate economic growth can help alleviate net debt burdens and ensure fiscal sustainability in Turkey.

4.1.1.5 Inflation rate analysis

Figure 4.5 charts show a comprehensive analysis of the inflation rate.

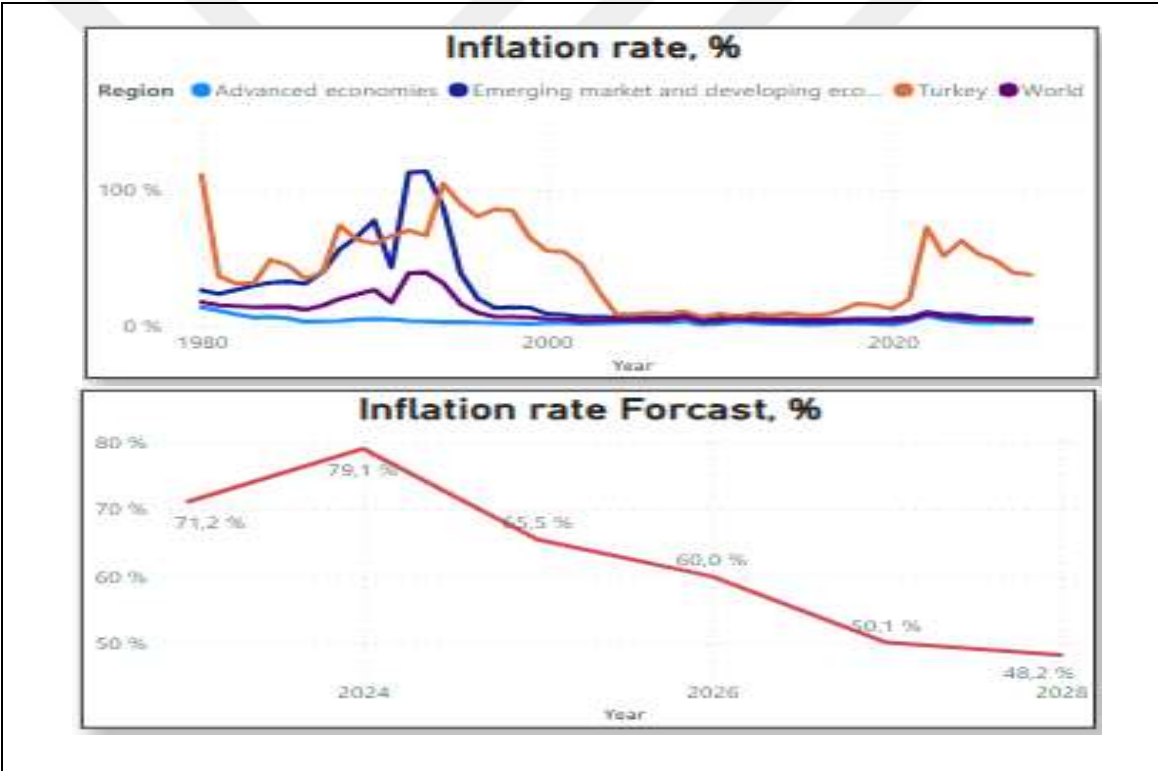


Figure 4.5: Inflation Rate Analysis.

a. Historical analysis

In 1993, Emerging market and developing economies contributed 3.05% to the average inflation rate within the region, indicating Turkey's significant role in shaping inflation dynamics.

Turkey consistently had the highest average inflation rate compared to Emerging market and developing economies, the World, and Advanced economies, signaling potential inflationary pressures within the country.

The year 2024 marked the highest sum of inflation rate in Turkey at 79.1%, significantly higher than the lowest sum recorded in 2028 at 48.2%. This substantial difference underscores volatility and potential challenges in managing inflation.

b. Forecast and implications

In 2028, Turkey experienced its lowest sum of inflation rate, reflecting efforts to stabilize prices and curb inflationary pressures.

Despite fluctuations, the overall range of inflation rate remained relatively wide, fluctuating between 48.2% and 79.1%.

c. Outlook

Addressing inflationary pressures is crucial for maintaining economic stability and fostering sustainable growth in Turkey. Implementing prudent monetary policies, controlling money supply, and addressing structural factors contributing to inflation are essential.

Collaboration with international organizations and economic partners can provide valuable insights and support in managing inflation dynamics.

Proactive measures to enhance price stability, promote competition, and improve productivity can help mitigate inflationary risks and ensure macroeconomic stability in Turkey.

4.1.1.6 Conclusion

The analysis of Turkey's net debt and inflation rate provides valuable insights into the nation's fiscal and monetary challenges, as well as their implications for long-term economic stability and growth.

a. Net debt concerns

Turkey faces significant challenges related to net debt, as evidenced by its contribution to the overall regional burden and disparities compared to Advanced economies. While fluctuations in net debt have been observed, the trajectory suggests potential fiscal pressures or increased borrowing. Addressing these concerns is paramount for ensuring fiscal stability and sustainable economic growth. Prudent fiscal policies, reduced reliance on borrowing,

and collaboration with international partners are essential strategies to mitigate net debt burdens and promote fiscal discipline.

b. Inflationary pressures

Turkey's historical analysis of inflation rate highlights the nation's consistent struggle with inflationary pressures. Despite efforts to stabilize prices, volatility remains a concern, with wide fluctuations observed over time. Managing inflation requires a multi-faceted approach, including prudent monetary policies, structural reforms, and international collaboration. By enhancing price stability, promoting competition, and improving productivity, Turkey can mitigate inflationary risks and ensure macroeconomic stability.

c. Conclusion

In conclusion, Turkey faces intertwined fiscal and monetary challenges that require proactive and coordinated efforts to address. Managing net debt burdens and inflationary pressures is essential for maintaining economic stability and fostering sustainable growth. Collaboration with international partners, prudent policy-making, and structural reforms are critical components of Turkey's path towards fiscal discipline and macroeconomic stability. By navigating these challenges effectively, Turkey can unlock its full economic potential and ensure prosperity for its citizens and future generations.

4.1.2 Consumer Analysis Report

4.1.2.1 Consumer credit trends

Turkey's economic landscape is marked by dynamic shifts in consumer behavior, financial inclusion initiatives, and evolving economic policies. Analyzing consumer credit trends and consumer confidence provides valuable insights into the factors shaping Turkey's economic trajectory.

Figure 4.6 chart shows a comprehensive analysis of consumer credit trends: Driving economic growth.

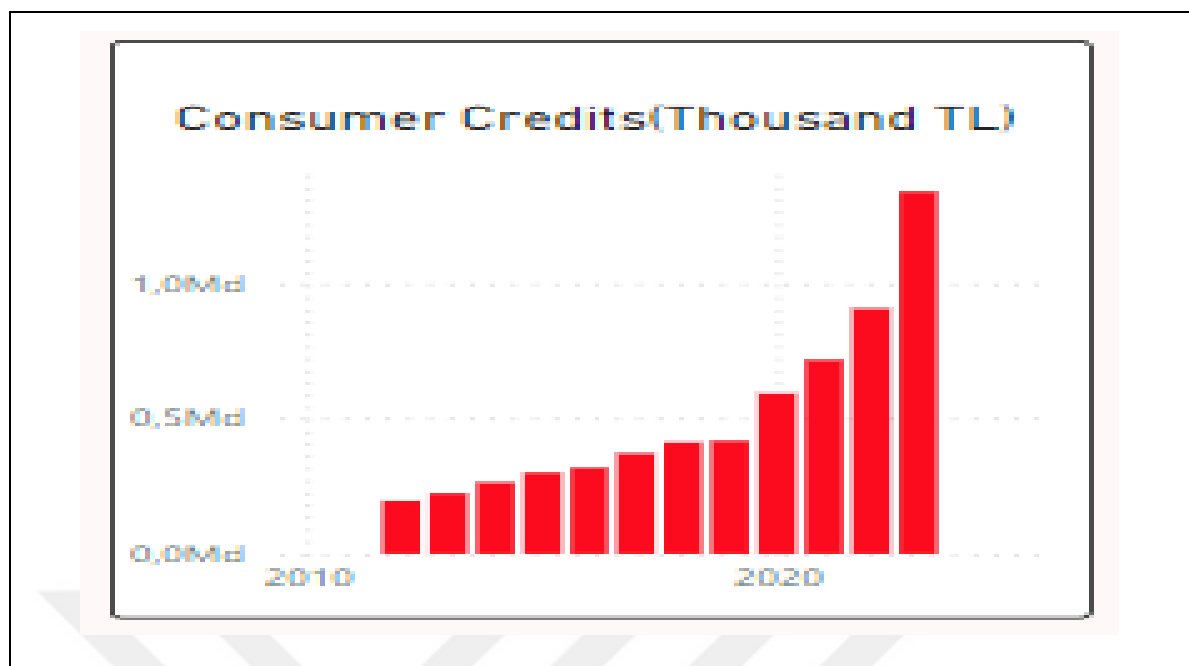


Figure 4.6: Consumer Credit Trends Analysis.

a. Remarkable growth (2012-2023)

Turkey experienced a remarkable surge in total consumer credits between 2012 and 2023, witnessing a staggering 591.14% increase. This surge reflects the growing demand for credit among consumers, driven by economic activities, lifestyle changes, and efforts towards financial inclusion. Increased access to credit has empowered consumers to pursue various economic endeavors, contributing to overall economic growth.

b. Accelerated rise (2018-2023)

The trend of consumer credits intensified notably starting in 2018, with a remarkable 226.80% increase over the span of five years. Factors such as increased consumer spending, investment, and accessible credit facilities have fueled this acceleration. The availability of credit has enabled consumers to make significant purchases, invest in businesses, and contribute to economic expansion.

c. Looking ahead: sustainable growth

Monitoring consumer credit trends is essential for informing economic policies and ensuring financial stability. It is imperative for policymakers to strike a balance between credit availability and responsible borrowing to sustain growth in the long term. By promoting financial literacy and implementing measures to mitigate risks associated with excessive

borrowing, Turkey can foster sustainable economic growth while safeguarding against financial instability.

4.1.2.2 Consumer confidence

Figure 4.7 chart shows a comprehensive analysis of the consumer confidence index.

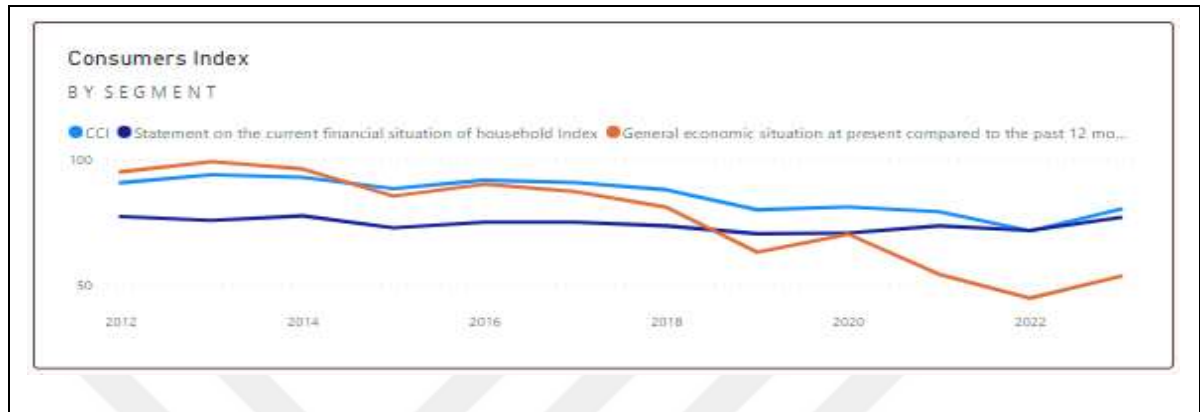


Figure 4.7: Consumer Confidence Index Analysis.

a. Historical analysis

Turkey experienced a notable downward trend in the Consumer Confidence Index (CCI) between 2012 and 2023, reflecting an 11.74% decrease. This decline suggests a gradual erosion of consumer sentiment and confidence over the analyzed period. The steepest decline occurred between 2017 and 2023, indicating a rapid decrease in consumer confidence within Turkey.

b. Forecast and implications

The downward trajectory of Turkey's CCI raises concerns about consumer sentiment and the overall economic outlook. Proactive measures are required to address underlying factors contributing to declining consumer confidence, which is crucial for stimulating consumer spending and supporting economic recovery. Collaborative efforts involving businesses, policymakers, and consumer advocacy groups can offer insights and strategies to boost consumer confidence and restore economic stability.

c. Outlook: rebuilding confidence

Forecasting future trends in Turkey's CCI necessitates close monitoring of economic indicators, consumer behavior, and external factors influencing sentiment. Implementing targeted policies to address economic challenges, promote employment opportunities, and enhance financial stability can help rebuild consumer confidence and support sustainable economic growth. Transparent communication, stakeholder engagement, and fostering trust

in economic policies are essential for restoring confidence and resilience in Turkey's economy.

d. Report conclusion: striking a balance for economic resilience

Combining insights from consumer credit trends and consumer confidence analysis provides a comprehensive understanding of Turkey's economic landscape. While the surge in consumer credits reflects positive economic growth and changing financial behaviors, the declining trend in consumer confidence underscores the need for proactive measures to restore sentiment and ensure economic resilience. By fostering responsible borrowing practices, promoting financial literacy, and implementing targeted policies, Turkey can navigate economic challenges and sustain long-term growth while safeguarding against financial risks.

4.1.3 Turkey Demographics Report

4.1.3.1 Population analysis

Figure 4.8 charts show a comprehensive analysis of male/female population.

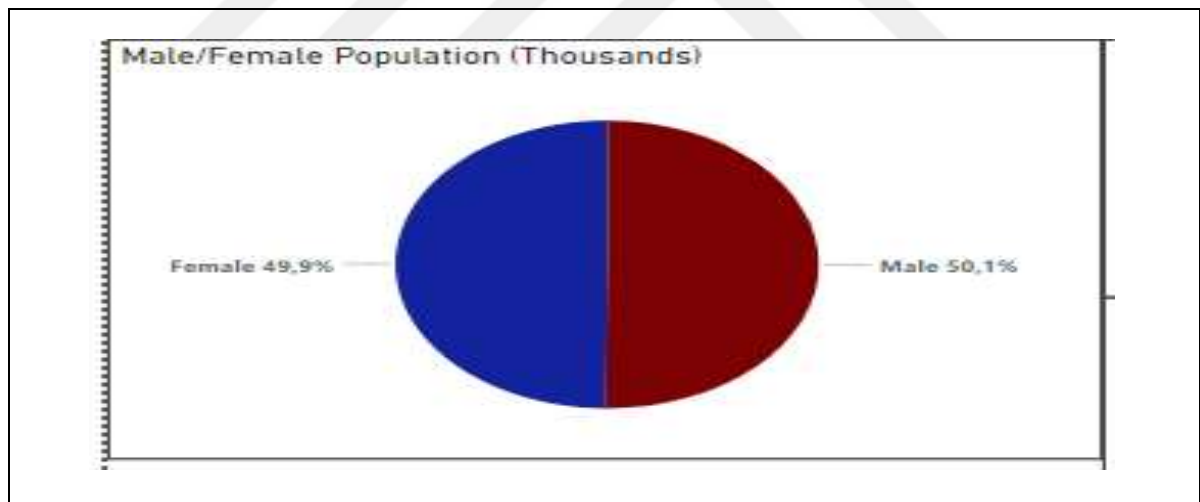


Figure 4.8: Male/Female Population.

Over the years, Turkey has maintained a balanced population distribution between males and females, with an average of approximately 100 males for every 100 females. This equilibrium in gender distribution is crucial for various societal and economic factors, including workforce participation, family structure, and social dynamics.

Figure 4.9 chart shows a comprehensive analysis of population change.

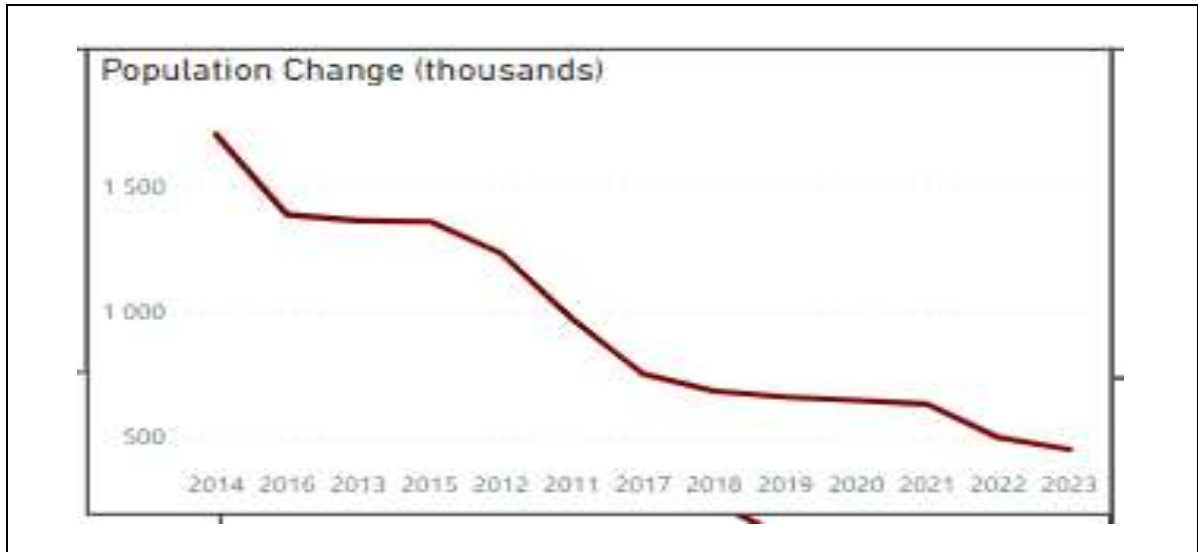


Figure 4.9: Population Change Analysis.

In 2014, Turkey experienced the highest average population change, reaching approximately 1,708.45 thousand, which was approximately 279.07% higher than the population change observed in 2023, at 450.70 thousand. Such significant fluctuations in population change highlight the dynamic nature of Turkey's demographics, influenced by factors such as migration trends, birth rates, and policy interventions.

Figure 4.10 chart shows a comprehensive analysis of rate of natural change.

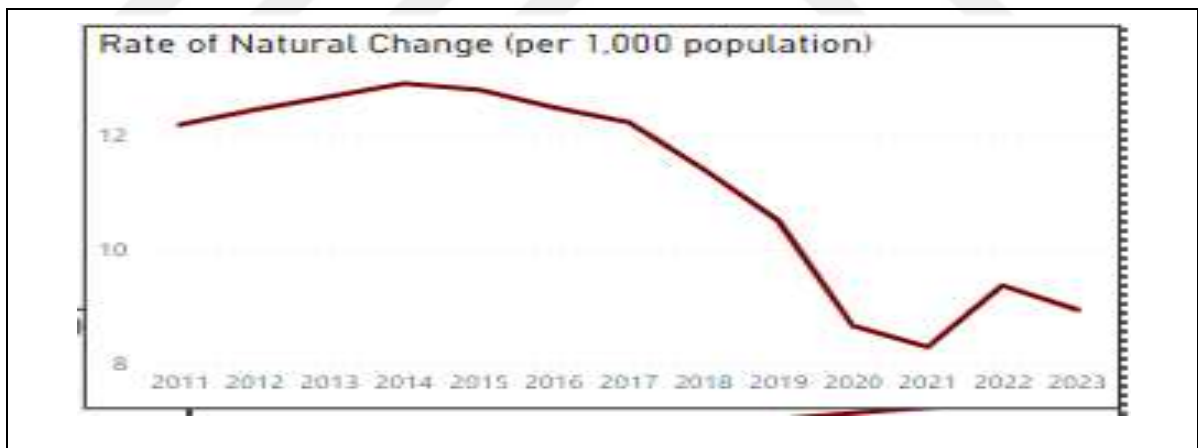


Figure 4.10: Rate of Natural Change Analysis.

The rate of natural change peaked in 2014 at approximately 12.93 per 1,000 population, which was approximately 56.11% higher than the lowest rate observed in 2021, at 8.28 per 1,000 population. This variation reflects shifts in birth rates, mortality rates, and societal trends over time, emphasizing the importance of understanding natural population dynamics for effective policy formulation and resource allocation.

Figure 4.11 chart shows a comprehensive analysis of sex ratio at birth.

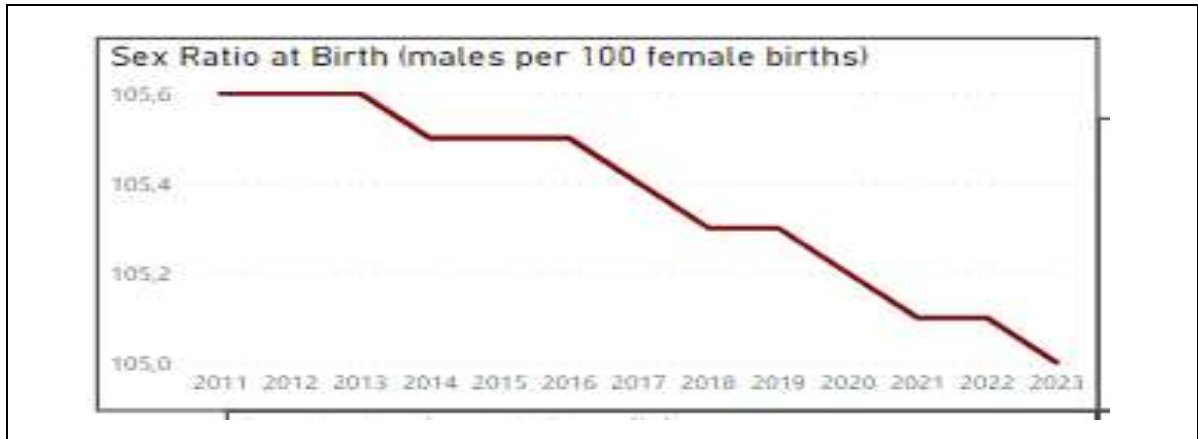


Figure 4.11: Sex Ratio At Birth Analysis.

The average sex ratio at birth remained stable over the 13-year period, ranging from approximately 105 to 105.60 males per 100 females. Despite minimal fluctuations, this slight male bias suggests consistent patterns in reproductive biology and societal preferences. Understanding these dynamics is essential for addressing gender disparities and promoting gender equality across various sectors.

Figure 4.12 chart shows a comprehensive analysis of total population.

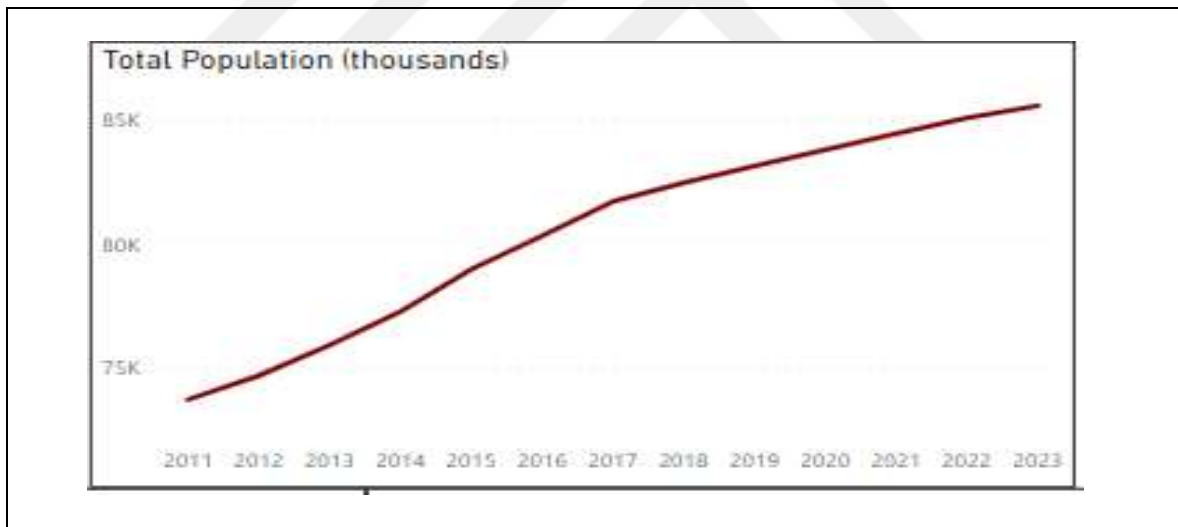


Figure 4.12: Total Population Analysis.

By 2023, Turkey's average total population reached approximately 85.6 million, a surge of approximately 16.15% compared to 2011. This sustained population growth reflects the interplay of birth rates, mortality rates, immigration patterns, and socioeconomic factors. As the population continues to expand, policymakers must focus on infrastructure development, resource management, and social welfare to ensure sustainable development.

Figure 4.13 chart shows a comprehensive analysis of population growth.

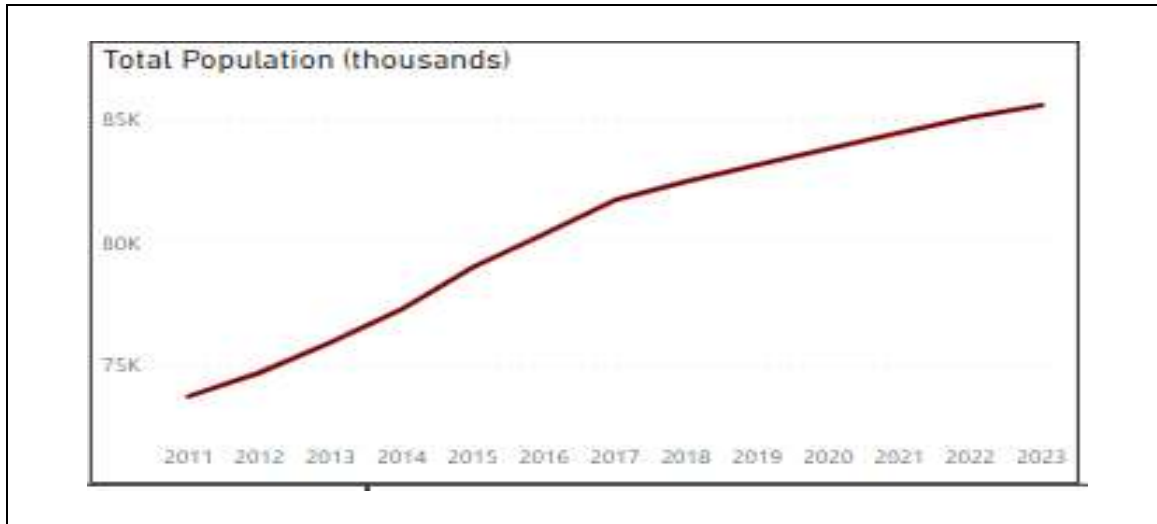


Figure 4.13: Population Growth Analysis.

The population growth rate peaked in 2014 at approximately 2.19%, significantly higher than the lowest rate observed in 2023, at approximately 0.53%. Such fluctuations in population growth underscore the complex interactions between demographic trends, economic conditions, and policy interventions. Sustainable population growth requires careful planning and investment in education, healthcare, and employment opportunities.

Figure 4.14 chart shows a comprehensive analysis of total population sex ratio.

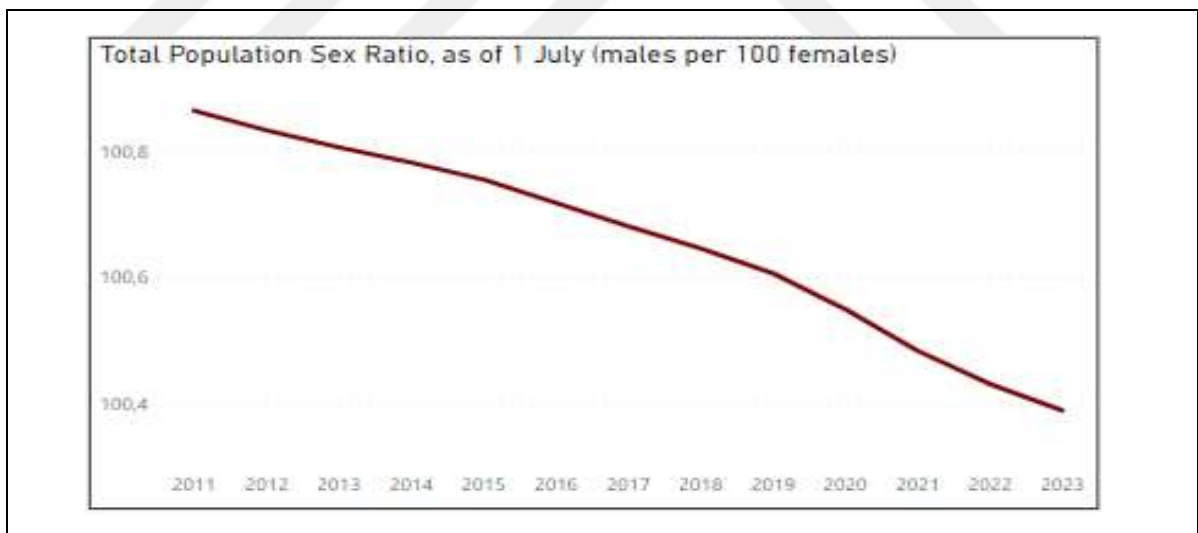


Figure 4.14: Total Population Sex Ratio.

Turkey exhibited a consistent average population sex ratio ranging from approximately 100.39 to 100.86 males per 100 females over the 13-year period. This stability in sex ratio reflects societal norms, cultural preferences, and reproductive patterns. Addressing gender imbalances and promoting gender equality remain key challenges for policymakers and social advocates.

4.1.3.2 Mortality analysis

Figure 4.15 chart shows a comprehensive analysis of mean age childbearing.

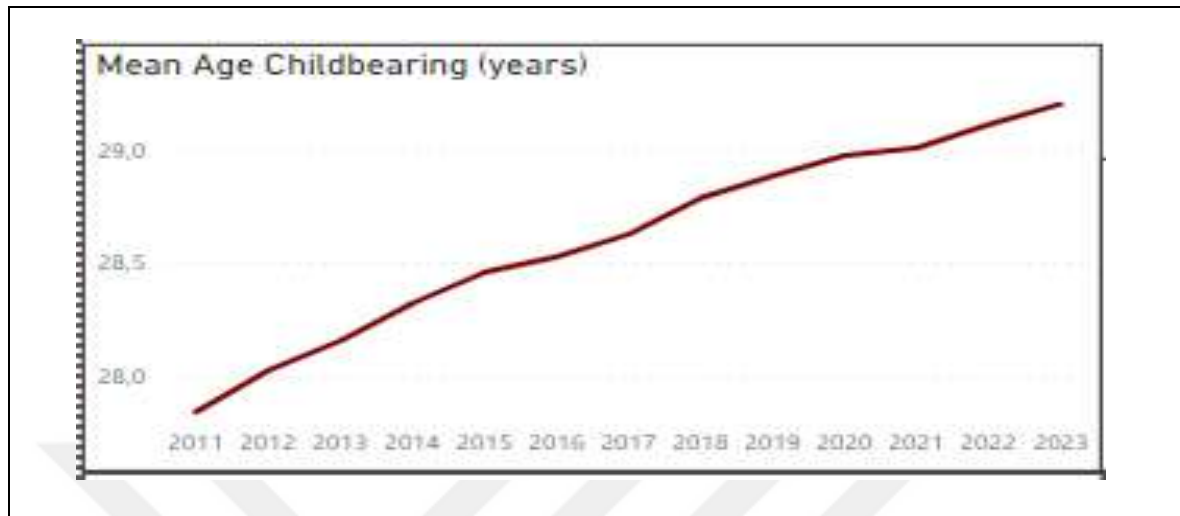


Figure 4.15: Mean Age Childbearing.

The mean age of childbearing increased from approximately 27.84 in 2011 to 29.20 in 2023. This upward trend suggests changing fertility patterns, influenced by factors such as education, career opportunities, and access to family planning services. Understanding shifts in maternal age is crucial for healthcare planning, maternal health promotion, and reproductive rights advocacy.

Figure 4.16 chart shows a comprehensive analysis of crude birth rate.

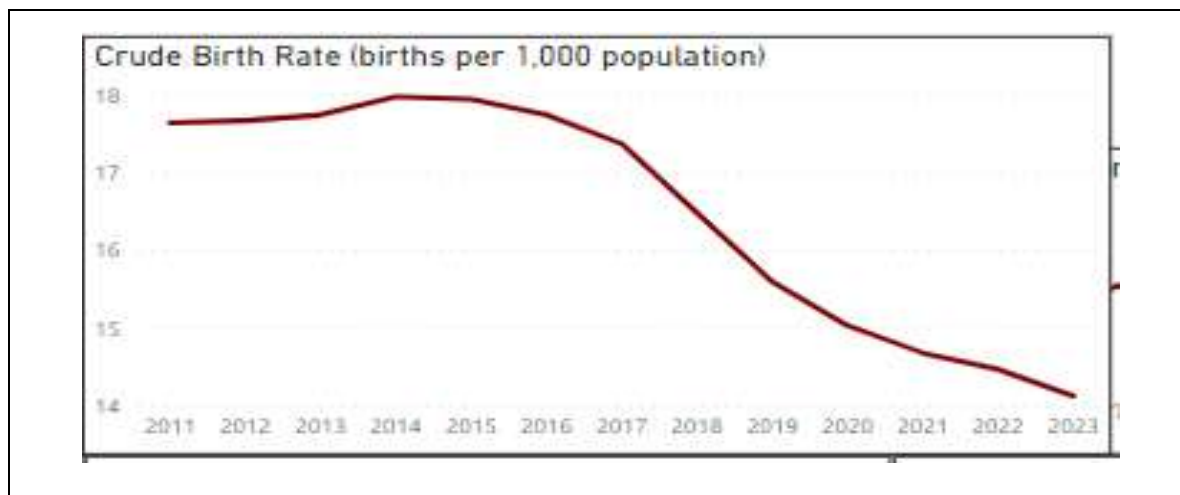


Figure 4.16: Crude Birth Rate Analysis.

The sum of crude birth rate peaked in 2014 at approximately 17.97 births per 1,000 population, declining to approximately 14.12 by 2023. These fluctuations in birth rates reflect changes in family planning practices, socioeconomic conditions, and healthcare

access. Maintaining optimal birth rates is essential for ensuring population stability and promoting maternal and child health.

Figure 4.17 chart shows a comprehensive analysis of births.

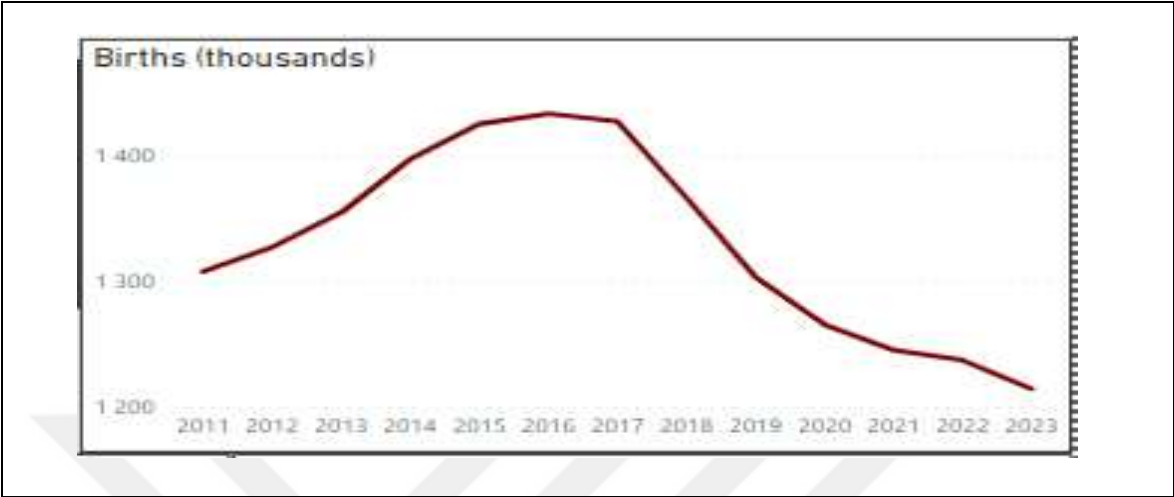


Figure 4.17: Births Analysis.

The average number of births peaked in 2016 at approximately 1.43 million, declining to approximately 1.21 million by 2023. This variation in birth numbers reflects fluctuations in fertility rates, maternal age, and reproductive behaviors. Investing in maternal and child health services, education, and social support systems is vital for ensuring positive birth outcomes and child well-being.

Figure 4.18 chart shows a comprehensive analysis of infant mortality rate.

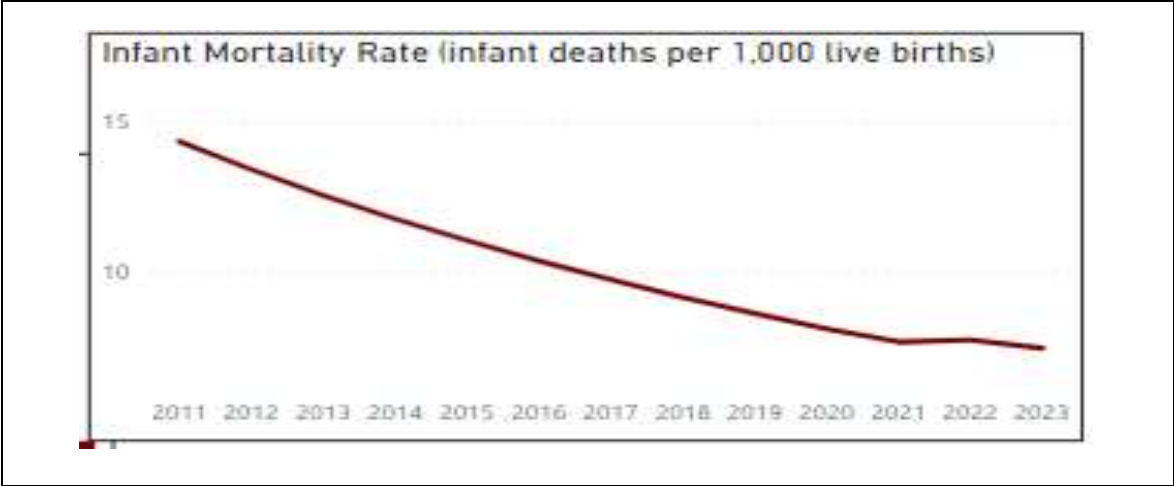


Figure 4.18: Infant Mortality Rate Analysis.

The highest average infant mortality rate was recorded in 2011 at approximately 14.31 deaths per 1,000 live births, decreasing to approximately 7.45 by 2023. This decline in infant mortality reflects improvements in healthcare infrastructure, maternal and child health

services, and public health interventions. Continued efforts are necessary to further reduce infant mortality and ensure equitable access to healthcare for all infants.

Figure 4.19 chart shows a comprehensive analysis of mortality per 1k live births.

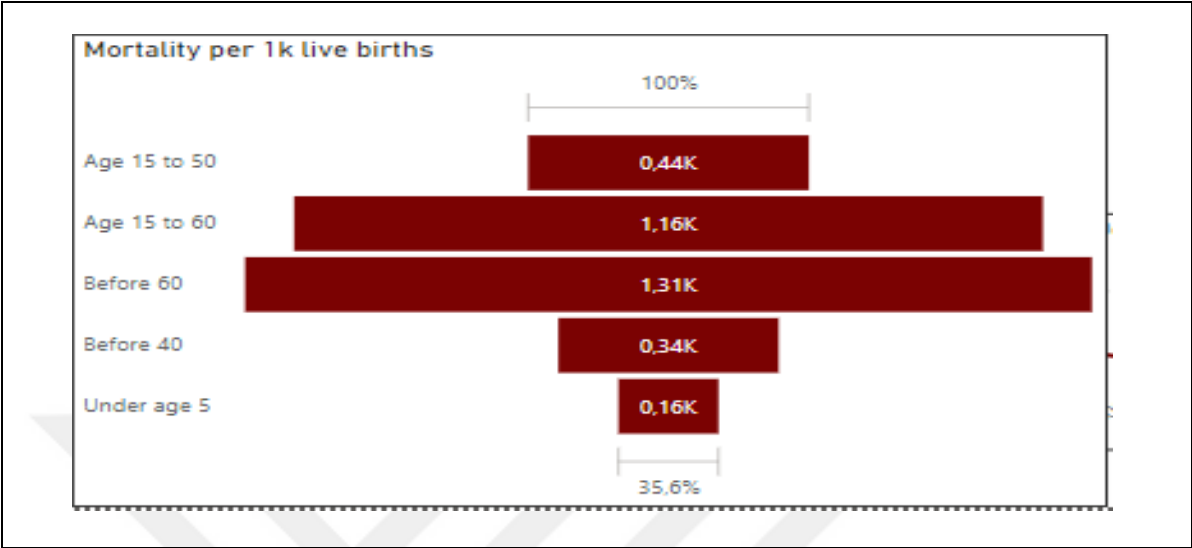


Figure 4.19: Mortality Per 1k Live Births Analysis.

The peak in mortality per 1,000 live births was observed in 2011 at approximately 14.31, declining to approximately 7.45 by 2023. This reduction in mortality rates signifies progress in healthcare delivery, disease prevention, and public health awareness. Strengthening healthcare systems, addressing socio-economic disparities, and promoting preventive care are essential for sustaining these positive trends in infant survival.

Figure 4.20 chart shows a comprehensive analysis of total deaths.

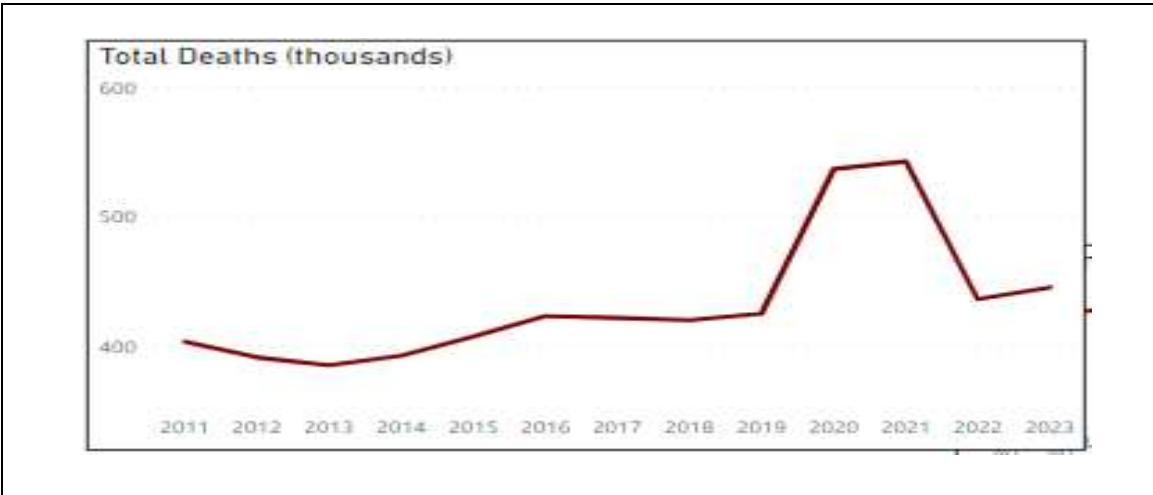


Figure 4.20: Total Deaths Analysis.

The lowest sum of total deaths was recorded in 2013 at approximately 384,970, increasing to approximately 542,600 by 2021. This rise in total deaths reflects population aging,

changes in disease prevalence, and improvements in life expectancy. Enhancing healthcare services, disease management, and palliative care is critical for addressing the needs of an aging population and ensuring quality end-of-life care.

Figure 4.21 chart shows a comprehensive analysis of total fertility rate.

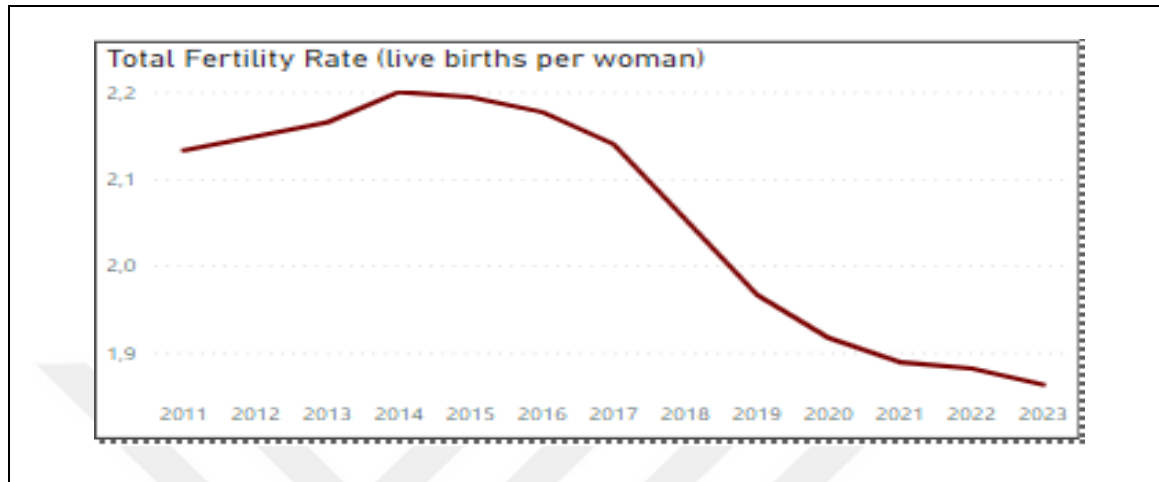


Figure 4.21: Total Fertility Rate Analysis.

The highest average total fertility rate was recorded in 2014 at approximately 2.20 live births per woman, declining to approximately 1.86 by 2023. This decrease in fertility rates reflects shifts in reproductive behaviors, increased access to family planning services, and changes in societal norms. Balancing desired family size with population sustainability requires comprehensive reproductive health policies and education initiatives.

4.1.4 Summary

Turkey's demographic landscape exhibits nuanced trends and complex dynamics across various key performance indicators (KPIs). In 2014, the nation witnessed demographic peaks across several metrics, including population change, growth rate, and crude birth rate, indicating robust population dynamics. These peaks were reflective of a period marked by favorable socio-economic conditions, increased healthcare access, and potentially higher fertility rates.

However, by 2023, Turkey experienced declines in these indicators, suggesting a shift in demographic patterns. The decline in population growth rate and crude birth rate may signify evolving societal norms, improved family planning practices, and possibly demographic aging. This transition underscores the multifaceted nature of demographic change, influenced by factors such as urbanization, education, and access to healthcare.

Historically, Turkey's population has been shaped by its geopolitical and socio-economic context, including its transition from the Ottoman Empire to a modern republic. The establishment of healthcare and education reforms during the early 20th century laid the groundwork for subsequent demographic shifts. Additionally, external factors such as migration, political instability, and conflicts have contributed to population fluctuations over time.

Looking ahead, forecasts suggest continued population growth, with projections exceeding 100 million in the next two decades. Policymakers must navigate the challenges associated with sustainable development, including infrastructure, healthcare provision, and economic opportunities. Addressing gender disparities, promoting social inclusion, and mitigating the impacts of demographic aging will be critical in ensuring a prosperous future for all citizens. In conclusion, Turkey's demographic trajectory reflects a dynamic interplay of historical legacies, socio-economic trends, and global influences. Understanding these complexities is essential for informed policy-making and strategic planning to meet the evolving needs of Turkey's diverse population.

4.2 MACHINE LEARNING RESULTS

Employing Python within the Visual Studio Code environment to load and preprocess the Turkey demographics data. Python (an interpreted, high-level programming language) has arguably become the de facto standard for exploratory, interactive, and computation-driven scientific research [7]. The easy interface and vast plugin ecosystem of Visual Studio Code provide seamless data manipulation and exploration, allowing to effectively manage enormous amounts of data while assuring its integrity and applicability for further machine learning tasks.

```
# Load data
df = pd.read_excel('/kaggle/input/turkey-demographics/Turkey Demographics.xlsx')
print(df.columns)

Index(['Index', 'Variant', 'Region, subregion, country or area *', 'Notes',
      'Location code', 'ISO3 Alpha-code', 'ISO2 Alpha-code', 'SDMX code**',
      'Type', 'Parent code', 'Year',
      'Total Population, as of 1 January (thousands)',
      'Total Population, as of 1 July (thousands)',
      'Male Population, as of 1 July (thousands)',
      'Female Population, as of 1 July (thousands)',
      'Population Density, as of 1 July (persons per square km)',
      'Population Sex Ratio, as of 1 July (males per 100 females)',
      'Median Age, as of 1 July (years)',
      'Natural Change, Births minus Deaths (thousands)',
      'Rate of Natural Change (per 1,000 population)',
      'Population Change (thousands)', 'Population Growth Rate (percentage)',
      'Population Annual Doubling Time (years)', 'Births (thousands)',
      'Births by women aged 15 to 19 (thousands)',
      'Crude Birth Rate (births per 1,000 population)',
      'Total Fertility Rate (live births per woman)',
      'Net Reproduction Rate (surviving daughters per woman)',
      'Mean Age Childbearing (years)',
      'Sex Ratio at Birth (males per 100 female births)',
      'Total Deaths (thousands)', 'Male Deaths (thousands)',
      'Female Deaths (thousands)',
      'Crude Death Rate (deaths per 1,000 population)',
      'Life Expectancy at Birth, both sexes (years)',
      'Male Life Expectancy at Birth (years)'])
```

Figure 4.22: Loading Data.

4.2.1 Machine Learning Models

To predict the 'Life expectancy at birth' for both sexes based on 'Total population' and 'Births,' we will begin by training several regression models: Linear Regression, Decision Tree, Random Forest, and Support Vector Machine (SVM). Subsequently, we will assess their performance using evaluation metrics such as Mean Squared Error (MSE) and R2 Score. This evaluation process aims to identify the most effective machine learning model for our research.

```

from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.svm import SVR
from sklearn.metrics import r2_score

# Features and target variable
X = df[['Total Population, as of 1 July (thousands)', 'Births (thousands)']]
y = df['Life Expectancy at Birth, both sexes (years)']

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Linear Regression
linear_model = LinearRegression()
linear_model.fit(X_train, y_train)
linear_predictions = linear_model.predict(X_test)
linear_mse = mean_squared_error(y_test, linear_predictions)
print(f'Linear Regression Mean Squared Error: {linear_mse}')

```

Linear Regression Mean Squared Error: 41.087572468737264

Figure 4.23: Linear Regression Model.

For model evaluation, we used the Mean Squared Error (MSE), it measures the model's accuracy in predicting continuous numeric values. It provides a quantitative evaluation of how well the model performs in terms of prediction error.

As depicted in Figure 4.23, the Linear Regression model produces an MSE value of approximately 41.09.

```

# Decision Tree
tree_model = DecisionTreeRegressor()
tree_model.fit(X_train, y_train)
tree_predictions = tree_model.predict(X_test)
tree_mse = mean_squared_error(y_test, tree_predictions)
print(f'Decision Tree Mean Squared Error: {tree_mse}')

```

Decision Tree Mean Squared Error: 3.488339040229886

Figure 4.24: Decision Tree Model.

As seen in Figure 4.24, the Decision Tree model produces an MSE value of approximately 3.49.

```
# Random Forest
rf_model = RandomForestRegressor()
rf_model.fit(X_train, y_train)
rf_predictions = rf_model.predict(X_test)
rf_mse = mean_squared_error(y_test, rf_predictions)
print(f'Random Forest Mean Squared Error: {rf_mse}')
```

Random Forest Mean Squared Error: 2.010513956794846

Figure 4.25: Random Forest Model.

As shown in Figure 4.25, the Random Forest model produces an MSE value of approximately 2,01.

```
# Support Vector Machine (SVM)
svm_model = SVR()
svm_model.fit(X_train, y_train)
svm_predictions = svm_model.predict(X_test)
svm_mse = mean_squared_error(y_test, svm_predictions)
print(f'SVM Mean Squared Error: {svm_mse}')
```

SVM Mean Squared Error: 61.5249011917061

Figure 4.26: SVM Model.

As shown in Figure 4.26, the SVM model produces an MSE value of approximately 61,52. R2 score is a statistical measure that represents the proportion of the variance in the dependent variable that is predictable from the independent variables. It ranges from 0 to 1, where a higher value indicates a better fit of the model to the data.

As shown in figure 4.27, the R2 scores for each model are printed to evaluate the performance of the models.:

```
# R2 Score for evaluation
linear_r2 = r2_score(y_test, linear_predictions)
tree_r2 = r2_score(y_test, tree_predictions)
rf_r2 = r2_score(y_test, rf_predictions)
svm_r2 = r2_score(y_test, svm_predictions)
print(f'R2 Score - Linear Regression: {linear_r2}')
print(f'R2 Score - Decision Tree: {tree_r2}')
print(f'R2 Score - Random Forest: {rf_r2}')
print(f'R2 Score - SVM: {svm_r2}')
```

```
R2 Score - Linear Regression: 0.29511895166871993
R2 Score - Decision Tree: 0.9401555280131705
R2 Score - Random Forest: 0.9655084712870656
R2 Score - SVM: -0.05549523237192666
```

Figure 4.27: R2 Score.

Linear Regression has an R2 score of 0.2951.

Decision Tree has an R2 score of 0.9281.

Random Forest has an R2 score of 0.9643.

SVM has an R2 score of -0.0555.

R2 score closer to 1 indicates a better fit of the model to the data, in this case Random Forest is the most performant while a negative R2 score (as in the case of SVM) indicates that the model performs worse than a horizontal line.

After identifying the most effective machine learning model for our research, which is [Random Forest](#), we will display the predictions made by this model for [Life Expectancy](#).


```
print(rf_predictions)
```

```
Random Forest Mean Squared Error: 2.010513956794846  
[72.96972 70.87871 81.43698 69.96557 80.89147 80.11904 64.67543 82.21465  
60.1485 78.67893 77.54195 77.43217 78.02752 77.89329 76.66781 51.18111  
78.05171 78.37997 67.99298 71.19933 72.99713 80.84103 73.67303 81.43418  
78.25452 72.1204 68.24247 68.39075 77.99938 82.70023 83.31344 80.82646  
71.19554 82.96633 77.03002 71.35879 80.41321 70.68639 57.38123 74.03066  
72.90828 73.92513 79.69818 70.55758 59.78295 68.57454 70.17643 67.08066  
81.29639 76.107 58.90542 83.79563 77.16248 79.99453 75.37766 80.84074  
65.45998 71.14269 64.53053 74.17622 76.3642 71.8968 76.31127 76.09349  
70.90756 82.08656 72.21264 82.44677 80.98534 66.29836 75.24659 56.74561  
80.96774 71.66322 70.60014 60.53843 73.09796 69.44487 70.19722 81.18962  
76.51139 69.61482 68.17058 60.03302 73.36687 69.45465 81.03579 59.98058  
78.09204 51.03664 67.74752 62.59021 68.47046 77.08901 59.97549 73.93379  
79.72003 77.64654 64.57912 58.50139 79.75273 71.76756 73.11491 79.03472  
63.29726 79.54548 72.96451 70.84833 76.09766 76.45495 74.62131 74.65485  
73.89061 73.80199 69.98937 72.98597 78.40933 76.03559 57.85375 64.35287  
67.21607 80.31981 79.20068 78.5211 77.97677 63.69934 77.41344 75.21676  
68.31782 61.96654 76.73439 80.96596 51.57158 68.86777 63.87414 60.29341  
63.97292 73.25654 74.64688 60.43407 60.27413 81.35984 80.67215 71.99292  
77.93911 74.23174 73.77273 64.55821 71.17311 81.18115 76.09323 74.37291  
80.42473 69.26174 64.43887 72.00561 65.85697 81.2152 76.51202 81.6447  
80.59408 59.68652 57.29367 69.43958 78.67839 81.97261 75.57524 64.52536  
73.48159 63.53001 82.17176 73.80991 71.10686 82.10072]
```

Figure 4.28: Random Forest Predictions.

As shown in figure 4.28, each predicted value represents the estimated life expectancy at birth for a given population size.

As a conclusion, the Random Forest model predicts life expectancy values ranging from approximately 51 to 83 years.

5. CONCLUSION

In this comprehensive analysis of Turkey's demographic, consumer, and economic indicators, several key insights emerge. Firstly, Turkey's demographic landscape exhibits a dynamic balance between population growth, fertility rates, and mortality trends. While the country has experienced fluctuations in population change and growth rates over the years, efforts to address gender disparities and promote reproductive health have contributed to overall stability.

Secondly, consumer credit trends and consumer confidence serve as vital indicators of Turkey's economic health. Despite significant growth in consumer credits over the past decade, declining consumer confidence poses challenges for sustained economic expansion. Balancing credit availability with responsible borrowing and addressing underlying factors affecting consumer sentiment are crucial for long-term economic stability and growth.

Finally, the analysis of GDP, net debt, and inflation rate trends underscores the complex interplay between fiscal and monetary factors shaping Turkey's economic outlook. While the nation has demonstrated resilience and potential for growth, challenges such as high net debt levels and inflationary pressures require strategic interventions and prudent policymaking to ensure sustainable development.

Turkey's path towards prosperity hinges on its ability to navigate demographic shifts, consumer behavior dynamics, and economic challenges effectively. By leveraging its strengths, implementing targeted policies, and fostering collaboration both domestically and internationally, Turkey can unlock its full potential and secure a prosperous future for its citizens.

In conclusion, while Power BI provided detailed visualizations of economic metrics, SQL Server facilitated data storage and management, enhancing the analytical process. Additionally, insights gleaned from Machine Learning models contributed to a deeper understanding of predictive trends. Ultimately, this research underscores the importance of leveraging diverse data sources and analytical techniques to gain holistic insights into economic dynamics, facilitating informed decision-making and strategic planning for stakeholders in Turkey's economy.

REFERENCES

- [1] Ramesh Sharda, Dursun Delen, and Efraim Turban, “Business Intelligence and Analytics: Systems for Decision Support”, 2014.
- [2] Murat Ozdemir, Eyup Emre Ulku and Kazim Yildiz, “Analysis and Comparison of Business Intelligence Tools Most Preferred by Companies in Turkey”, 2023.
- [3] Akram Jalal Karim, “The value of Competitive Business Intelligence System (CBIS) to Stimulate Competitiveness in Global Market”, 2011.
- [4] Audrey Langlois and Benjamin Chauvel, “The impact of supply chain management on business intelligence”, 2017.
- [5] Prakash Ukhalkar and Monali Bhosale, “The role of Big data in enhancing business value through Business Intelligence and Big Data Analytics”, 2020.
- [6] Sultan Saeed and Suhail Ahmed, "Machine Learning in the Big Data Age: Advancements, Challenges, and Future Prospects", 2024.
- [7] K. Jarrod Millman and Micheal Aivazis, "Python for Scientists and Engineers", 2011.