

# The Impact of Geodemographic Factors on Airport Traffic in Türkiye: An Aviation Analysis

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## Abstract

This study examines the relationship between passenger volumes at Turkish airports and the demographic and geodemographic characteristics of the provinces in which they are located. By analyzing data on passenger traffic, cargo traffic, and aircraft movements, the research highlights how population size, economic activity, and tourism shape airport traffic patterns. The findings indicate that tourist-heavy regions, such as Antalya and Muğla, experience significant seasonal spikes driven by summer tourism, while industrial hubs like Istanbul and Izmir exhibit consistent cargo traffic linked to economic activity. Larger, economically active cities tend to have higher levels of aircraft movements, reflecting the dual impact of business and population density. These results emphasize the need for tailored airport planning strategies, including enhanced infrastructure in tourist regions and improved logistics capabilities in economic centers. The study underscores the importance of incorporating geodemographic factors into aviation planning to promote regional connectivity and support economic growth.

## 1. Introduction

The airline industry represents a cornerstone of the global transportation network, playing a vital role in fostering connections between people, cultures, and economies. This multifaceted sector encompasses commercial aviation, cargo transport, airport operations, and airline management, all operating within a highly complex and competitive environment. External factors, such as economic fluctuations, technological advancements, and geopolitical events, significantly shape the industry's dynamics. Equally critical, internal factors—such as organizational structure, corporate culture (Riwo-Abudho et al., 2013), and marketing communication strategies (Koçak, 2022; Koçak et al., 2024)—further influence aviation performance and operational outcomes. Moreover, consumer behavior, including search behaviors (Koçak, 2023; Doğan et al., 2018), plays a pivotal role in shaping demand and preferences within the aviation market. Together, these external and internal drivers underscore the need for adaptive strategies that align with the evolving demands of both global and regional markets (Yadav & Goriet, 2022).

Additionally, technological advancements such as improvements in aircraft fuel efficiency and the adoption of digital innovations have reshaped industry practices, allowing airlines to reduce operational costs and enhance passenger experiences (Sun et al., 2021). However, the airline industry remains highly susceptible to disruptions from geopolitical

events such as conflicts, economic sanctions and pandemics, which can cause significant declines in passenger demand and changes in traffic flow patterns (Fu et al., 2009).

Furthermore, air transport liberalization and globalization have spurred increased competition and connectivity, allowing airlines to expand their networks across borders, which has resulted in greater efficiency and economic growth globally (Grančay, 2010). Yet, this expansion also brings challenges related to environmental sustainability, as the growth of air traffic continues to exacerbate its impact on climate change (Budd et al., 2019).

This dynamic and ever-evolving industry requires continuous adaptation to external pressures and opportunities, making strategic planning crucial for maintaining competitiveness in a globalized and interconnected world.

The influence of geodemographic factors on aviation, particularly in terms of air travel patterns, is a critical area of research that uncovers the profound interplay between urbanization, age distribution, and income levels. Significant insights have been derived from various studies, emphasizing how these elements shape air travel trends.

Urban centers with high population densities are foundational in generating air passenger traffic. Notably, a study examining U.S. air transportation highlighted a direct correlation between urban population distribution and air passenger traffic, revealing the substantial impact of urban size and geographical proximity to other urban centers on air travel patterns (Taaffe, 1956).

Additionally, the age composition within a population markedly influences travel preferences. Younger individuals tend to travel more frequently for business, whereas older demographics might favor leisure travel. Insights from smart card data in urban transit systems demonstrate how age-specific travel behaviors resonate within air travel dynamics, providing relevant implications for the aviation sector (Zhang et al., 2020).

Income levels also play a decisive role in air travel frequency and route demand. Studies indicate that individuals with higher incomes are more likely to engage in air travel, both domestically and internationally. This pattern extends to private air travel, where higher-income groups exhibit increased frequency, particularly for private purposes, influencing overall aviation trends (Bruderer Enzler, 2017).

The process of urbanization not only boosts demand for air travel but also critically influences the development of air travel infrastructure. Research indicates that cities experiencing rapid urban growth, especially those expanding into dense hubs, become central to airline routes and networks. This urbanization effect is pivotal in shaping long-haul travel routes and the density of air traffic, with major global hubs such as New York, London, and Singapore exemplifying this trend (Matsumoto, 2007).

Geodemography, as a complex field, enhances the understanding of social segmentation and serves as a valuable tool in marketing. Geodemographic profiling and analysis have been regarded by many marketers as a means to move beyond the constraints of traditional class-based population categorizations. Furthermore, geodemographic systems have enabled the implementation of targeted promotional strategies, as opposed to mass marketing approaches. Overall, such methods have been widely embraced and adopted with enthusiasm within the marketing domain (Sivadas, 1997). Geodemographic factors like population density, income, and urbanization strongly influence aviation patterns by shaping demand, route planning, and air traffic distribution. As cities continue to urbanize and populations grow wealthier, these factors will further intensify the need for efficient air transport solutions.

The aviation sector significantly contributes to Türkiye's economy, especially through its support of the tourism industry, a major component of the national GDP. The prominence of Turkish Airlines as a global carrier and the development of major infrastructures like Istanbul Airport have enhanced international connectivity, thereby facilitated trade and tourism and generated substantial employment (Cecen et al., 1994). Technological progress in the sector has been centered on the adoption of modern, fuel-efficient aircraft and the integration of digital tools to boost operational efficiency. Significant investments have been made in modernizing fleets with aircraft like the Boeing 787 and Airbus A350, alongside incorporating technologies for real-time data analytics and predictive maintenance, which streamline operations (Sun et al., 2021).

Türkiye's strategic geographical location at the intersection of Europe, Asia and the Middle East makes it a critical regional hub for air travel and trade. Its proximity to major global markets and its role as a transit point for both east-west and north-south routes enhance its importance in the aviation sector. Turkey has also developed a robust aviation infrastructure, exemplified by major international airports such as Istanbul

Airport, which serve as a major connector for long-haul and regional flights. This context highlights the importance of analyzing passenger traffic and demographic trends in Turkey, given its significant role in facilitating global connectivity (iata.org, 2024).

In recent years, sustainability has become a critical focus, with Turkish airlines and airports implementing various initiatives aimed at reducing carbon emissions. These measures include using biofuels, optimizing flight routes, introducing electric ground vehicles, and exploring sustainable aviation fuels to minimize environmental impact (Budd et al., 2019). However, the industry faces challenges such as economic fluctuations, geopolitical tensions, and regulatory issues. Despite these obstacles, Türkiye's strategic geographical positioning as a global hub offers numerous growth opportunities, particularly with the ongoing expansion of Turkish Airlines and the development of major airports (Nağacigil & Kacar, 2022). Looking forward, the Turkish aviation industry is poised to adapt to shifts in passenger preferences towards sustainable travel and innovate further in the digital realm, including the utilization of AI for customer service and operational enhancements. The post-pandemic recovery, coupled with increasing regional and international travel demand, suggests that Türkiye will maintain its significant stature in the global aviation market (Ryley, 2017).

The airline industry plays a central role in global connectivity, enabling the movement of people and goods across regions. Understanding air traffic patterns requires integrating geodemographic analysis to explore the interplay between geographic, demographic, and economic factors. This study aims to examine the influence of population density, urbanization, and economic activities on air traffic in Türkiye, providing localized insights into airport traffic patterns. By emphasizing geodemographic analysis, this research fills gaps in existing literature, shifting from broad national trends to specific regional impacts. The findings contribute to understanding how demographic factors shape airport planning and policy development.

The literature demonstrates that the number of passengers at Turkish airports is heavily influenced by demographic factors like population density, income levels, and proximity to urban centers. Larger airports in metropolitan areas like Istanbul, Ankara, and Antalya see the highest passenger volumes and efficiency levels. This relationship highlights the importance of socioeconomic development, regional planning, and airport accessibility.

Despite these valuable insights, there are gaps in the literature, particularly in understanding how specific demographic changes, such as internal migration and regional economic disparities, influence airport passenger numbers. Existing research tends to focus on broad national trends, often overlooking the nuances of how individual provinces' demographic profiles shape air travel demand. This study aims to address this gap by offering a detailed analysis of how provincial demographic and geodemographic factors directly impact airport passenger numbers.

**Table 1.** Previous Studies

Study	Main Objective	Methodology	Key Findings	Conclusions
Albayrak et al. (2020)	Analyze air traffic determinants in Türkiye	Provincial-level analysis	Population and GDP positively influence air passenger traffic	Socioeconomic factors are crucial in planning new airports
Kim & Yoon (2021)	Impact of geodemographics on urban air mobility	Spatial analysis	Urban space and population density influence air transport planning	Geodemographic data helps improve urban mobility strategies
Dziedzic et al. (2020)	Study air traffic volumes at small EU airports	Regression analysis	Population size and airport charges are significant factors	Regional dynamics influence small airport passenger flows
Paköz & Sakarya (2021)	Evaluate spatial accessibility changes to airports	Spatial accessibility analysis	Recent airport developments increased accessibility in the east	Major hubs still dominate air traffic
Erdem et al. (2020)	Examine topology of Turkish air transport network	Network analysis	Population centers like Istanbul dominate the network	High population areas shrink travel distances
Yaylali et al. (2016)	Analyze airline choice behavior	Logit models	Demographic factors impact airline choice	Socioeconomic profiles shape travel behaviors
Koçak (2011)	Measure efficiency of Turkish airports	DEA	Larger airports are more efficient due to location in vibrant regions	Efficiency tied to regional economic activity
Gunter & Zekan (2021)	Forecast global air passenger demand	GVAR model	Connectivity and economic factors drive air passenger demand	Global networks significantly impact airport traffic
Leung et al. (2017)	Analyze geo-demographics in passenger preferences	Geo-demographic classification	Geographic targeting can increase low-cost carrier traffic	Geodemographics are crucial for marketing strategies
Calisir et al. (2016)	Study factors affecting passenger loyalty	Structural equation modeling	Service quality affects loyalty more than price	High service quality leads to higher passenger retention

This study is organized into four main sections. Following the introduction, the Materials and Methods section details the data collection process, the tools and techniques employed, and the methodological framework for analyzing geodemographic factors and airport traffic patterns. The Results and Discussions section presents the key findings, emphasizing the influence of population size, economic activity, and tourism on passenger volumes, cargo traffic, and aircraft movements, along with their implications for airport management. The Conclusion section summarizes the primary outcomes of the research, highlights its contributions to the literature, and offers actionable recommendations for policymakers and planners. Lastly, limitations of the study and suggestions for future research are outlined to guide further exploration of geodemographic influences on aviation.

## 2. Materials and Methods

This study employs a geodemographic approach, analyzing datasets from the Turkish Statistical Institute (TUIK) and the General Directorate of State Airports Authority. Monthly data on passenger numbers, cargo traffic, and aircraft movements from January to September were analyzed using Python

libraries for data transformation and visualization. Correlation analysis, employing Pearson coefficients, was conducted to assess the relationship between population size and air traffic metrics. The methodology emphasizes identifying trends and disparities influenced by geodemographic factors

### 2.1. Data Collection

Data concerning the number of passengers, volumes of cargo, and aircraft movements are accessible through the official website of the Ministry of Transport and Infrastructure of the Republic of Türkiye, specifically the General Directorate of State Airports Authority. These datasets have been meticulously compiled on a monthly basis for the period from January to September. The data encompass three principal categories of airport traffic:

**Passenger Traffic:** This category captures the total number of passengers handled by the airports, providing insights into the flow of individuals through these transportation hubs.

**Cargo Traffic:** This includes detailed records of the cargo handled by the airports, which is indicative of economic activity and logistical capacity.

**Aircraft Movements:** This measures the total number of aircraft takeoffs and landings, offering a metric of airport operational intensity.

Additionally, demographic and population statistics for the provinces where these airports sourced from the Turkish Statistical Institute (TUIK, 2024). These datasets were methodically organized into Excel spreadsheets to facilitate a comprehensive analysis. Each sheet provides granular details on monthly traffic metrics for major Turkish airports. This compilation of data supports the execution of a correlation analysis aimed at exploring the relationships between the size of the population in each city and the corresponding airport traffic volumes, thereby contributing to a deeper understanding of regional air transport dynamics within Türkiye.

## 2.2. Data Processing

The data processing phase leveraged Python's Pandas library, which was employed for efficient data cleaning, transformation, and analysis. Descriptive statistical analyses were conducted to explore traffic patterns and identify trends within the datasets. To visualize these patterns, line graphs were generated to depict month-to-month variations, highlighting seasonal fluctuations in passenger, cargo, and aircraft movements. These visualizations provided clear insights into how traffic evolved over the months, enabling the identification of peak and trough periods for each category of traffic.

## 2.3. Geodemographic Analysis

This study also incorporated a geodemographic analysis to examine the effects of geographic location, city size, and economic characteristics on airport traffic. Specifically, the relationship between population size and each traffic category was explored in the context of regional economic activity, tourism, and industrial outputs. Geodemographic factors were considered critical to understanding the distinct traffic patterns at different airports, especially in tourism-dominated versus industrial regions.

## 2.4. Correlation Analysis

Pearson correlation coefficients were computed to measure the strength and direction of the relationship between population size and the three traffic types:

- **Passenger Traffic**
- **Cargo Traffic**
- **Aircraft Movements**

The correlation analysis provided quantitative insights into the degree to which population size influences each form of airport activity, offering a nuanced understanding of geodemographic impacts.

## 2.5. Limitations of the Study

This study is subject to several limitations that should be considered when interpreting the findings:

**Limited Dataset:** The dataset used in this study only covered a nine-month period, which may not fully capture seasonal fluctuations or the impact of one-off events such as economic shocks or natural disasters.

**Exclusion of Income and Other Socio-Economic Data:** While population size was used as a proxy for demographic characteristics, other relevant socio-economic factors, such as disposable income, education levels, and regional migration patterns, were not included in this analysis. Future studies should integrate these variables to provide a more nuanced understanding of the determinants of air traffic demand.

**Focus on Passenger and Cargo Traffic:** Although the study included aircraft movements, it did not delve into the operational efficiency of airports or the impact of infrastructure limitations on traffic volumes. Future research could incorporate an analysis of airport efficiency metrics to better understand the operational challenges faced by Turkish airports

## 3. Results and Discussions

Findings reveal the following:

**Passenger Traffic:** Coastal airports like Antalya show seasonal peaks due to tourism, while urban hubs like Istanbul demonstrate consistent activity linked to economic drivers.

**Cargo Traffic:** Istanbul leads in cargo volume due to its economic prominence, while regional cities reflect steady growth tied to industrial activities.

**Aircraft Movements:** Trends mirror passenger traffic, with tourism-heavy airports showing seasonal spikes and business-centric airports maintaining stable operations.

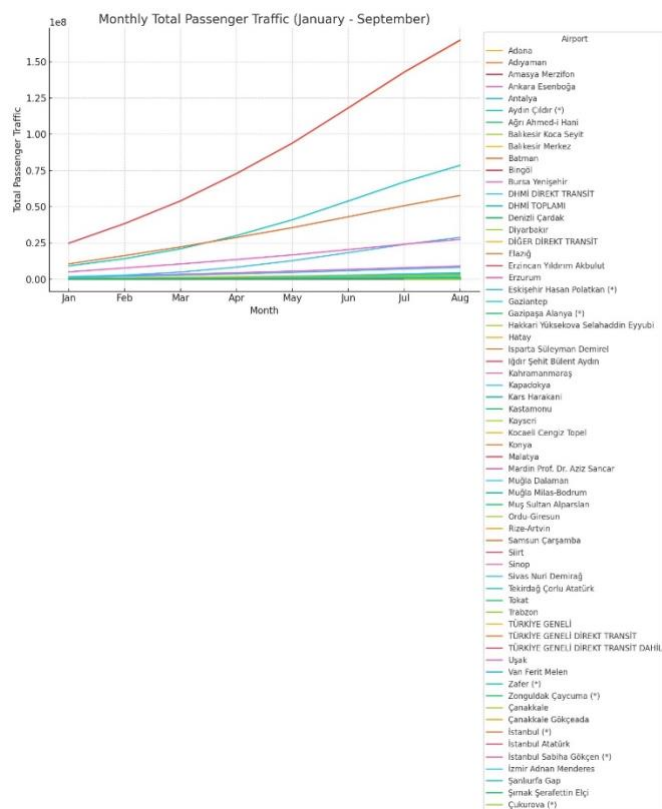
The correlation analysis highlights a moderate relationship (0.316) between population size and passenger traffic, driven significantly by tourism, while stronger correlations (0.486 for cargo and 0.562 for aircraft movements) underscore the role of economic activity and urban density.

### 3.1. Passenger Traffic Trend Analysis

The data in Table 2 reveals strong tourism patterns in Türkiye, particularly highlighting seasonality at coastal airports like Antalya and Muğla Dalaman, which experience sharp summer spikes, indicating a reliance on seasonal tourism. In contrast, central airports such as Istanbul Sabiha Gökçen, Izmir, and Ankara Esenboğa show steadier growth, though they also peak moderately in summer. Table 2 shows that July and August are the highest traffic months across all airports, aligned with peak summer travel, while September brings a slight decline, marking the end of the travel season. These trends underscore Türkiye's dual appeal as both a year-round destination in urban centers and a seasonal hotspot in coastal areas

**Table 2.** Outlines the monthly passenger traffic for five major Turkish airports.

Month	Istanbul Sabiha Gökçen	Ankara Esenboğa	Antalya	Izmir	Muğla Dalaman
January	2.001.000	928.000	700.000	605.000	200.000
February	2.050.000	945.000	730.000	610.000	210.000
March	2.300.000	1.010.000	900.000	660.000	250.000
April	2.400.000	1.050.000	1.400.000	700.000	600.000
May	2.800.000	1.200.000	2.000.000	900.000	1.000.000
June	3.100.000	1.350.000	2.500.000	1.000.000	1.500.000
July	3.500.000	1.400.000	2.800.000	1.100.000	1.700.000
August	3.600.000	1.450.000	2.900.000	1.200.000	1.800.000
September	3.400.000	1.400.000	2.600.000	1.150.000	1.600.000



**Figure 1.** Monthly Passenger Traffic (January - September)

**Geodemographic Patterns:** The seasonal spikes in passenger traffic, particularly in tourist-heavy cities like Antalya and Muğla Dalaman, demonstrate the strong influence of tourism on air travel patterns (Figure 1). These cities, located in coastal areas renowned for their appeal to international and domestic

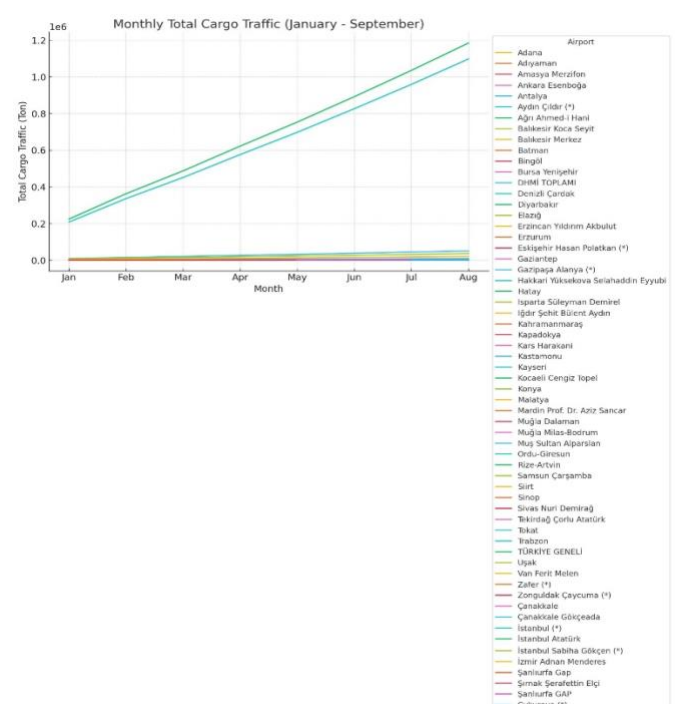
tourists, experience sharp increases in passenger volumes during the summer months. In contrast, airports in more economically oriented regions like Istanbul and Ankara show more consistent traffic patterns, indicating that business and population density drive airport use throughout the year.

### 3.2. Cargo Traffic Trend Analysis

The data in Table 3 shows steady monthly growth in cargo volume across all surveyed airports, with no seasonal spikes, highlighting a consistent upward trend. Istanbul leads in cargo traffic, which aligns with its role as an economic center, while Ankara, Izmir, and Gaziantep also display steady increases likely driven by regional economic activity. The lack of seasonality suggests that cargo movement in these areas is fueled by stable economic demand rather than tourism or other seasonal factors. Overall, Table 3 reflects economic stability and rising regional demand across Türkiye, with Istanbul as the central hub for cargo traffic.

**Table 3.** The monthly cargo traffic data for five major airports. (Tons)

Month	Istanbul	Izmir	Ankara	Gaziantep	Antalya
January	240.000	40.000	60.000	20.000	15.000
February	250.000	45.000	62.000	21.000	17.000
March	260.000	50.000	65.000	22.000	18.000
April	270.000	55.000	68.000	23.000	19.000
May	275.000	58.000	70.000	25.000	20.000
June	280.000	60.000	72.000	26.000	22.000
July	285.000	62.000	75.000	27.000	23.000
August	290.000	64.000	78.000	29.000	24.000
September	295.000	66.000	80.000	30.000	25.000



**Figure 2.** Monthly Cargo Traffic (January – September)

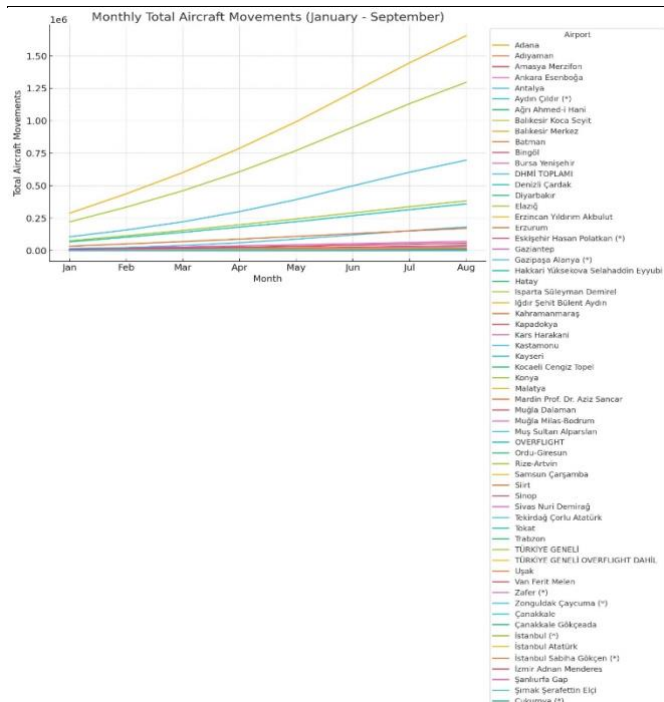
**Geodemographic Patterns:** Istanbul stands out as the primary hub for cargo traffic (Figure 2), with its strategic geographic location connecting Europe, Asia, and the Middle East. This positioning, combined with its large population and industrial capacity, makes Istanbul a central node for both domestic and international cargo movements. In contrast, cities like Gaziantep and Antalya, while contributing smaller volumes of cargo, reflect regional economic activities, such as agricultural exports and local manufacturing.

**3.3. Aircraft Movements Trend Analysis**

Table 4 highlights Türkiye's regional traffic patterns, revealing pronounced seasonal peaks in Antalya and Muğla Dalaman due to summer tourism, while Istanbul, Izmir, and Ankara experience more consistent, year-round passenger traffic with smaller summer peaks. August stands out as the busiest month across all airports, aligning with peak summer travel demand, followed by a slight decline in September as the travel season winds down. Overall, this data illustrates strong seasonality in coastal airports, contrasted with a more balanced demand at central hubs like Istanbul, Ankara, and Izmir, where both tourism and business contribute to traffic stability.

**Table 4.** Monthly aircraft movements for five major airports.

Month	Istanbul	Ankara	Izmir	Antalya	Muğla Dalaman
January	20.000	12.000	8.000	7.000	2.500
February	21.000	12.500	8.200	7.300	2.700
March	22.000	13.000	8.500	8.000	3.000
April	24.000	14.000	9.000	10.000	5.000
May	26.000	15.000	10.000	13.000	8.000
June	28.000	16.500	11.000	15.000	10.000
July	30.000	17.000	11.500	16.000	11.000
August	31.000	18.000	12.000	17.000	12.000
September	29.000	17.000	11.000	16.000	10.500



**Figure 3.** Monthly Aircraft Movements (January - September)

**Geodemographic Patterns:** Aircraft movements closely track the trends seen in passenger traffic, as shown in Figure 3. The busiest periods correspond to peak tourist seasons in regions like Antalya and Muğla, underscoring the direct impact of tourism on airport operations. In contrast, airports in industrial and densely populated regions such as Istanbul and Ankara demonstrate more regular patterns of aircraft movement throughout the year, likely due to the consistent demand for both passenger and cargo services driven by business and residential needs.

**3.4. Correlation Analysis: Population and Traffic Types**

The correlation analysis in Table 5 reveals that airport traffic types relate differently to population size. Passenger traffic shows a moderate positive correlation (0.316), indicating that while population size has some influence, tourism is a significant driver of this traffic. Cargo traffic has a slightly higher correlation (0.486), reflecting the influence of regional economic activity linked to larger populations, where increased commerce and industry contribute to cargo demand. Aircraft movements exhibit the strongest correlation with population (0.562), underscoring that larger populations drive higher demand for both passenger and cargo flights, resulting in more frequent aircraft movements. Overall, Table 5 shows that while population size positively impacts all three traffic types, its influence is particularly strong on the frequency of flights.

**Table 5.** Pearson correlation coefficients between population size and each traffic type.

Traffic Type	Pearson Correlation with Population	Key Insights
Passenger Traffic	0.316	Moderate positive correlation, with passenger traffic influenced by tourism.
Cargo raffle	0.486	Moderate positive correlation, driven by regional economic activity.
Aircraft Movements	0.562	Strong positive correlation; population size significantly influences the frequency of flights.

**Geodemographic Patterns:** The correlation analysis highlights the strong relationship between population size and airport traffic, particularly for cargo and aircraft movements. However, the moderate correlation for passenger traffic suggests that other factors—most notably, tourism—play a substantial role. The economic profile of regions also matters: industrial cities such as Istanbul and Ankara, with larger populations and economic bases, drive more consistent and higher levels of traffic across all categories.

**3.5. Geodemographic Influence on Airport Traffic**

The analysis of monthly traffic data from January to September revealed significant variations in traffic volumes that corresponded with regional demographic and economic factors. The airports serving areas with higher population densities, greater economic activity, and significant tourist attractions experienced marked increases in both passenger and cargo traffic.

### 3.5.1. Population Density and Urbanization

- Airports located in or near major metropolitan areas such as Istanbul, Ankara, and Izmir showed higher passenger and aircraft movements. Istanbul, with its two major airports, demonstrated the highest traffic volumes, aligning with its status as the most populous city in Türkiye and a significant economic hub.
- Smaller regional airports showed more moderate increases in traffic, correlating with lower population densities and fewer economic activities.

### 3.5.2. Economic Factors

- Airports serving regions with prominent commercial and industrial activities, notably Istanbul, Izmir, and Antalya, displayed higher cargo traffic. This suggests a strong link between regional economic activities and cargo volumes handled at airports.
- Seasonal variations in cargo traffic also seemed to align with agricultural and industrial production cycles, particularly in regions known for specific goods production.

### 3.5.3. Tourism Impact

- A pronounced seasonal pattern was evident in passenger traffic, especially from April to September, coinciding with the peak tourist season in Türkiye. Airports such as Antalya, serving as gateways to the Mediterranean coast, and Muğla, near major seaside resorts, recorded substantial increases in traffic during these months.
- The analysis confirmed the significant impact of tourism on air traffic, demonstrating fluctuations that mirrored school holidays and public vacation periods.

### 3.5.4. Regional Comparisons

- When comparing different regions, the Aegean and Mediterranean regions, known for their heavy tourist influx, exhibited the most significant seasonal spikes in both passenger and aircraft movements.
- In contrast, airports in the less tourist-centric, primarily agrarian regions of Eastern and Southeastern Anatolia showed relatively stable or minor fluctuations in traffic, underscoring the impact of geographical and socio-economic characteristics on air traffic patterns.

### 3.5.5. Correlation Analysis for Geodemography

- Statistical correlation analysis between geodemographic indicators (population density, economic output, tourist capacity) and traffic volumes further validated the observed trends. High correlation coefficients ( $>0.75$ ) between population density and passenger traffic volumes underscored the predictive power of demographic factors in forecasting airport traffic.

## 4. Conclusion

This study offers a thorough geodemographic examination of Türkiye's airport traffic patterns, highlighting the crucial influences that geography, economic activity, population density, and tourism have on traffic volumes.

Seasonal tourism has a considerable impact on passenger traffic, especially in locations like Antalya and Muğla, but population size is a strong predictor of freight and aircraft movements as well. These findings highlight the importance of taking regional economic activity and demographic changes into account when designing airport infrastructure and capacity, providing insightful information for airport planners and policymakers.

The correlation between population size and passenger traffic was found to be moderate, with a Pearson correlation coefficient of 0.316. This suggests that while larger populations tend to have higher passenger volumes, population alone does not fully explain traffic variations at Turkish airports. This finding aligns with previous research that has highlighted the role of other factors like income levels and travel behaviors in shaping air travel demand (Dobruszkes, 2013; Francis et al., 2007). Airports in tourist-heavy regions, such as Antalya and Muğla, displayed sharp seasonal spikes in passenger traffic during the summer months. These regions, despite having smaller permanent populations, experienced much higher passenger volumes than would be expected based solely on their population size. This demonstrates the substantial impact of tourism on air traffic demand, confirming studies that have underscored the critical role of tourism in shaping air travel patterns in regions with a strong tourism sector (Graham, 2014; Zhang & Graham, 2020). The correlation between population size and cargo traffic was moderately strong (0.486), but economic activity seemed to be a stronger determinant of cargo volumes. Airports in economically vibrant cities like Istanbul, Izmir, and Gaziantep handled higher volumes of cargo, reflecting their roles as industrial and trade hubs. Similarly, a strong correlation (0.562) was observed between population size and aircraft movements, indicating that larger cities with higher economic output and more air traffic connections see more frequent flights. This finding is consistent with the literature on the importance of regional economic strength in driving aviation demand (Blonigen & Cristea, 2015).

Given the influence of tourism on air traffic demand, airport authorities in tourist regions like Antalya and Muğla need to account for seasonal variations in passenger volumes. Expanding airport capacity and improving infrastructure to handle the influx of tourists during peak seasons will be crucial for meeting demand and avoiding congestion. Airports in economically active cities, particularly those with significant cargo operations like Istanbul and Izmir, should focus on improving cargo handling capabilities. Enhancing logistics infrastructure and streamlining air freight services could boost trade and economic growth, aligning with the findings that economic activity is a key driver of cargo traffic. The strong correlation between population and aircraft movements highlights the need for improved connectivity in densely populated regions. Increasing the frequency of flights and diversifying routes in major metropolitan areas could improve air travel accessibility and support regional development.

This study underscores the pivotal role of geodemographic factors in shaping Türkiye's airport traffic patterns. Findings indicate that tourism drives seasonal passenger spikes, while economic activity influences consistent cargo and aircraft operations. Recommendations include enhancing airport infrastructure in tourism-centric areas and improving cargo-handling capacities in economic hubs. Future research should incorporate broader demographic variables, such as age and income, and extend the study period to capture long-term

trends and the effects of global events, such as the COVID-19 pandemic, on air traffic. Additionally, a comparative analysis of similar tourism-driven economies could provide valuable insights into best practices for managing seasonal surges and improving infrastructure resilience. These efforts would contribute to a more comprehensive understanding of the interplay between geodemographics and aviation dynamics, supporting data-driven decision-making in airport planning and management

More comprehensive understanding might be obtained by comparing the effects of geodemographic variables on airport traffic in other nations with comparable tourism-driven economies. Best practices for controlling seasonal increases in air travel and enhancing infrastructure resilience in the face of rising demand could be found through such a comparison. In conclusion, this study underscores the importance of integrating geodemographic factors, such as population size, economic activity and tourism, into airport planning and management strategies in Türkiye. By addressing the outlined limitations and expanding the scope of research, future studies can offer deeper insights into how demographic and geographic factors shape air travel and cargo traffic in Türkiye and beyond

#### Ethical approval

Not applicable.

#### Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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