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ANALYZING THE CRITERIA AFFECTING TRANSITION TO AIRPLANE BY COMPARING DIFFERENT METHODS*

HAVA SEYAHATİNE GEÇİŞİ ETKİLEYEN KRİTERLERİN FARKLI YÖNTEMLERİN KARŞILAŞTIRILMASI YOLUYLA ANALİZİ

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Abstract

This study, using the multi-vehicle approach, discusses the criteria affecting the transition from alternative transportation modes (car, train, bus) to air transportation between city pairs that neither have a hub status nor non-stop flights between them. If these criteria change, the demand for air transportation will increase. For this purpose, a survey was conducted in the provinces of Kayseri and Bursa, which are among the important trade, industry, and tourism centers in Turkey, in the course of three months between January and March, 2018. Logistic regression, the artificial neural network model, and clustering analyses were applied to the data compiled from questionnaires responded to by 501 individuals in Kayseri and 453 individuals in Bursa. According to the empirical findings, it was concluded that the most significant criteria in the transition to air transportation according to all three methods are the cost of travel/ticket price and non-stop flight. Additionally, it was observed that the Artificial Neural Networks (ANN) model made more accurate predictions compared to others. This study is important since it compares three different methods for the purpose of criteria determination concerning the choice of transportation modes.

Keywords: Air Travel Demand, Travel Behaviour, Air Travel Demand, Travel Behaviour, Logistic Regression, Artificial Neural Networks, Cluster Analysis.

Öz

Bu çalışmada, ana merkez statüsünde olmayan ve aralarında aktarmasız uçuş bulunmayan şehir çiftleri arasında alternatif ulaşım modlarından (otomobil, tren, otobüs) havayolu ulaşımına geçişe etki eden kriterler ile hangi kriterlerin değişmesi durumunda havayolu ulaşımına olan talebin artacağı çok araçlı yaklaşımla (hava, kara, deniz ulaşımı) ele alınmıştır. Bu amaçla, Ocak-Mart 2018 tarihleri arasında 3 aylık dönemde Türkiye'nin önemli ticaret, sanayi ve turizm merkezlerinden Kayseri ve Bursa illerinde anket çalışması yapılmıştır. Kayseri'de yaşayan 501, Bursa'da yaşayan 453 bireye uygulanan anketlerden derlenen verilere lojistik regresyon, yapay sinir ağları modeli ve kümeleme analizleri uygulanmıştır. Veri setinin analizi sonucunda elde edilen ampirik bulgulara göre, havayolu ulaşımına geçişte en önemli kriterlerin her üç yönteme göre de seyahat maliyeti/bilet fiyatının uygunluğu ile aktarmasız/direkt ulaşım olduğu sonucuna ulaşılmıştır. Çalışmada elde edilen önemli bir bulgu da Yapay Sinir Ağları (YSA) modelinin diğer modellere göre daha başarılı kestirim yaptığı yönünde olmuştur. Bu çalışma, üç farklı yöntemin de karşılaştırmalı olarak ele alındığı öncül çalışmalardan biri olması açısından önemlidir.

Anahtar Kelimeler: Hava Seyahat Talebi, Seyahat Davranışı, Lojistik Regresyon, Yapay Sinir Ağları, Kümeleme Analizi.

GENİŞLETİLMİŞ ÖZET

Çalışmanın Amacı

Bu çalışmada ana merkez (hub) statüsünde olmayan ve aralarında aktarmasız uçuş bulunmayan şehir çiftleri arasında alternatif ulaşım modlarından (özel araç, otobüs, tren) uçağa geçişte etkili olan önemli talep değişkenleri ile hangi değişkenlerin değişmesi durumunda hava ulaşımına olan talebin artacağı lojistik regresyon, yapay sinir ağları ve kümeleme analizleri yapılarak belirlenmeye çalışılmıştır.

Araştırma Soruları

Araştırma problemini, "Kayseri ve Bursa illeri arasında karşılıklı aktarmasız uçuşlar için yeterli talep var mıdır?" ve "Uçuş talebindeki artışta hangi değişkenlerin önemli etkisi vardır?" soruları oluşturmaktadır.

Literatür Araştırması

Türkiye'de havayolu ile taşınan yolcu sayısında 2003 serbestleşmesinden bu yana taşınan iç hat yolcu sayısında önemli artışlar görülse de yurtiçi yolcu taşımacılığın hala büyük bir bölümü karayolu üzerinden gerçekleşmektedir. Yurtiçinde havayolu ulaşımının payının artmasıyla birlikte yolculuk süreleri büyük oranda kısalacaktır. Böylelikle şehirlerarası turizmin ve ticaretin gelişmesi, şehirlerarasındaki ekonomik ve sosyal farklılıkların giderilmesi beklenmektedir. Türkiye'de ana merkezlerden yapılan uçuşlar haricinde ise uçuşlar çok az sayıda nokta arasında yapılmaktadır. Ana merkezler haricindeki noktalar arasındaki uçuşlar bağlantılı uçuşlarla gerçekleştirilmektedir. Bağlantılı uçuşlar, uzun aktarma (bekleme) süreleri ve yüksek bilet fiyatlarından dolayı cazip gelmemektedir. Rekabetçi, dinamik ve karmaşık yapısıyla havacılık sektöründe doğru yapılmış bir talep tahmini, hangi hatta ne kadar sıklıkta uçuş konulacağı, bilet fiyatlarının nasıl belirleneceği, ne kadar kaynak ve kapasite kullanılacağının tespitinde önemlidir. Nitekim doğru yapılmış bir talep tahmini, havayolu işletmelerinin gelirlerinde büyük farklar yaratacaktır. Doğru sonuçlar veren talep tahmin çalışması doğru seçilmiş talep değişkenlerine bağlıdır. Dünyada havayolu talep tahmini konusunda yapay sinir ağları yöntemiyle yapılmış çalışmalar mevcut iken, bu alanda kümeleme analizi yapan bir çalışmaya rastlanmamıştır. Ayrıca bu çalışmanın, şehir çiftleri arasında çapraz uçuş talebini belirleme amacına yönelik 3 yöntemi (regresyon, yapay sinir ağları ve kümeleme analizleri) aynı veri setine uygulayarak analiz sonuçlarını karşılaştırma yoluna giden öncül çalışmalardan biri olması beklenmektedir.

Yöntem

Bu çalışma, iki ya da daha çok değişken arasında birlikte değişim varlığını belirlemeyi amaçlayan ilişkisel tarama yaklaşımıyla desenlenmiştir. Araştırmanın evrenini Kayseri ve Bursa illerinde ikamet eden bireyler oluşturmuştur. Şehir çiftleri arasında havayolu ulaşımına geçişte etkili olan faktörleri belirlemeye yönelik model geliştirirken literatürde kullanılmış değişkenler (regresörler ya da belirleyiciler) ile uzman görüşlerinden faydalanılmıştır. Hava yolculuğu talep tahmininde model geliştirmek üzere, ilişkisel yöntemlerden biri olan regresyon analizi, doğru tahmin için yaygın olarak

kullanılan ve güvenilir bir yöntem olan yapay sinir ağı analizi (YSA) ve bireyleri uzaklık ve yakınlık kriterlerine göre kümelere ayırmak için kümeleme analizleri kullanılmıştır.

Sonuç ve Değerlendirme

Ana merkez statüsünde olmayan ve aralarında direkt uçuş bulunmayan şehir çiftleri arasında alternatif ulaşım modlarından (otobüs, özel araç, tren) uçağa geçişte etkili olan değişkenler ile bu değişkenlerin değişmesi ile incelenmiştir. Lojistik regresyon, yapay sinir ağları ve kümeleme analizlerinin yapıldığı çalışmada en önemli değişenlerin her üç yöntemde de ilgili şehir çiftinde direkt uçuş olup olmaması ile bilet fiyatının/seyahat maliyetinin uygunluğu olduğu sonucuna ulaşılmıştır. Bununla birlikte çalışma sonucunda Yapay Sinir Ağları (YSA) modelinin hayır'ların kestiriminde daha başarılı olduğu görülmüştür. Lojistik regresyon analizinin hayır'ların kestirimde başarısız olduğu görülmüştür. Kümeleme analizi ise orta derecede uyum ve ayırma kalitesi gösterdiğinden dolayı, model oluşturmada beklenildiği düzeyde başarılı bulunamamıştır. Dolayısıyla Yapay Sinir Ağları (YSA) modelinin diğer modellere göre daha başarılı kestirim yaptığı sonucuna ulaşılmıştır. Bulunan sonuç, Seo ve Kim (2003), Sivrikaya ve Tunç (2013) çalışmalarını desteklemektedir. Ana merkezlerin havayolu ulaşım yükünün hafifletilmesi açısından diğer iller arasında aktarmasız uçuşların teşvik edilmesi uygun olacaktır. Bu çalışmanın ayrıca havayolu şirketlerine yeni rotalar oluşturma kararlarında rehberlik etme potansiyeline sahip olduğuna inanılmaktadır. Bu çalışmanın sınırlılıklarından biri, sadece bir şehir çiftinde yapılmış olmasıdır. Çalışmanın daha fazla şehir çifti için yapılmasının genel tabloyu daha iyi yansıtabilecek daha anlamlı sonuçlar üreteceği öngörülmektedir. Diğer bir sınırlama, zaman kısıtlamalarının daha büyük bir örneklem büyüklüğüne izin vermemesidir. Gelecekteki çalışmalarda örneklem büyüklüğünün artırılması, hedef şehirlerin ana havalimanlarının yanı sıra alternatif havalimanlarının da modele dahil edilmesi ve farklı tahmin yöntemleri ile analiz edilmesi kuvvetle önerilmektedir.

1. INTRODUCTION

The development of air transport not only enables faster and comfortable travel, but also contributes to the development of international trade and tourism. Concerning transportation, increasing the global value of countries and the level of welfare is only possible by eliminating regional inequalities. This is achievable by administering the same quality and uninterrupted transportation to every corner of the country.

In 2019, approximately 4.4 billion passengers were carried on scheduled services around the world. In Turkey, for the same year this number increased by 159% compared to 2003, when liberalization in the airline industry was introduced. Although there have been fluctuations ever since in the number of passengers from year to year as a whole, this figure has increased by approximately 6% annually (Worldbank, 2021). However, the aviation and transportation sector were among those mostly affected by the Covid-19 pandemic, which began in early 2020 and led to an estimated 66% reduction in revenue passenger kilometers (RPKs) worldwide (IATA, 2021), since consumers were dominantly at home and experienced deductions in road, education, and other social expenses due to quarantines (Cici and Bilginer, 2021). The travel data company, Cirium (2021), determined that 42 commercial airlines ceased operations completely and went bankrupt in 2020. This number was 46 in 2019 and 56 in 2018. On the other hand, studies are underway for 30 new airlines, some of which are officially established while others are in this process. With the end of the pandemic, it is expected that people's mobility will increase with the urge for travel caused by staying at home for a long time.

With the liberalization policy initiated in 2003, the aviation sector in Turkey has grown approximately three times more than the global growth every year. The Aviation Liberalization Project, initiated in line with the goal of every Turkish citizen and getting on an airplane at least once in their life, has revived domestic flights to a large extent. Also, with the aim of ensuring that every Turkish citizen does fly everywhere in the world, international flights have been boosted as well.

Despite significant increases in the number of domestic passengers since 2003 in Turkey, approximately 90% of them are still transported by road. The share of domestic air transport was 9.43% in 2018 (Çevre ve Şehircilik Bakanlığı, 2021). Due to Turkey's mountainous and rugged geographical structure and large surface area, road transportation takes place in long and difficult conditions. With the increase in the share of domestic air transportation, travel times are expected to be shortened considerably. Thus, the development of intercity tourism and trade, and the elimination of economic and social differences between cities can also be anticipated as a result of such developments.

The majority of airline companies in Turkey use Istanbul as their main hub. There are domestic non-stop flights from Istanbul to almost every airport in the country. Other hubs include Ankara, Antalya, and Izmir.

Flights other than those from the main hubs in Turkey, are made between very few destinations. These flights are operated by means of connections, which are not popular due to long transfer (waiting) times and high ticket prices.

In this study, it has been tried to determine the significant demand variables that are effective in the transition from alternative transportation modes (car, bus, for train) to air transportation between city pairs that do not have a hub status, do not have non-stop flights between them, and where such variables are expected to increase the demand for air transportation. For this purpose, the provinces of Bursa and Kayseri were chosen as the city pair for this implementation. Due to its geographical location, Bursa is considered as an important crossroads; furthermore, as stated before, it is a key tourism, industry, and trade center, and its population is increasing year by year with the migrations it receives. The province of Kayseri, on the other hand, is an important trade center in Central Anatolia. Whether there is sufficient demand for non-stop flights in air transportation between these two provinces is a crucial criteria on to decide whether to set up routine flights between them. For a company, demand forecasting accounts for making vital business decisions, such as production quantity, the resources and the capacity it needs, pricing, and product development. Correct demand forecasting reduces risk and helps the business to evaluate its strategic options. In the competitive, dynamic, and complex aviation sector, an accurate demand forecast is significant in determining how often flights are planned on which route, how ticket prices are set, and how much resource and capacity will be used. An accurate demand forecast will make a great difference in the revenues of airline companies. However, demand forecasting that gives accurate results depends on carefully selected demand variables. Many statistical methods are used in demand forecasting among which are regression analysis, time series analysis, clustering, and artificial neural networks.

This study employs regression analysis, which is one of the relational methods in air travel demand forecasting, artificial neural network analysis (ANN) as a widely used and reliable method for accurate forecasting, and clustering to divide individuals into clusters according to distance and proximity criteria and aims to develop a model.

While there have been studies on airline demand forecasting using artificial neural networks, as far as the authors are concerned, there has been no such effort to use cluster analysis in this area. In addition, this study is expected to be a pioneering one to compare analysis results by applying three methods (regression, artificial neural networks, and clustering analysis) to the same data set to determine the non-stop flight demand between city pairs.

2. LITERATURE REVIEW

Van Can (2013) analyzed and investigated domestic tourists' choice of travel mode by using Multinominal Nested Logit Model. It has been found that while the increased travel cost and duration

statistically reduced airline sales; increased level of comfort, level of safety versus quality level, price or punctuality increase sales statistically significantly.

Jung and Yoo (2014) determined whether there is a difference in the behavior of flag carriers, cost leaders and high-speed train mode selection among intercity business/leisure passengers by using Multinominal Nested Logit ve Nested Logit Models. It has been found that while the increase in ticket prices, access time to airport and travel time reduce the possibility of passengers to choose the relevant travel mode; service frequency was found to be statistically insignificant.

Wang et al. (2014) investigated the travel mode choice behavior in intercity journeys, to define the factors affecting the travel mode shift. It has been found that the increase in travel cost and time reduces the possibility of passengers choosing the relevant travel mode.

Valdes (2015) studied to measure the factors that determine air travel demand in middle-income countries. By using static-dynamic panel data models, income elasticity was found to be the most important determinant of air travel demand.

Wang et al. (2018) studied to measure the effect of high-speed train on airline traffic and price theoretically and empirically. By applying Log-linear demand and supply (pricing) simultaneously equations on panel data, it has been found that low cost carriers can reduce the airfare and stimulate the demand in Indıa. In both China and India, airport concentration positively affect air travel demand.

Boonekamp et al. (2018) studied to identify the most important determinants of air travel demand. By applying Two-stage least squares method to Cross-sectional data, it has been concluded that the ethnic connections between the countries, the share of aviation employment, and the presence of low cost carrier on the route lead to an increase in passenger demand.

Zhou et al. (2019) studied to explore travel behavior and travel mode choice of airline passengers and communities in Western Australia. Travel cost, travel time, service frequency, and seat comfort play an important role in travel mode preference.

In this study, while developing a model to determine the factors affecting the transition to air transportation between city pairs, the variables used in the literature (regressors or determinants) and expert opinions have also been utilized. As stated earlier, correctly determined demand variables are essential for an accurate demand forecast. Some variables used in previous studies are shown in Table 1.

Table1. Some Demand Variables Used in Previous Studies

No	Author, date	Data	Variables (Reggresions)
1	Van Can (2013)	Survey	Distance, travel time (km), travel cost (km)/income, travel mode's service quality, income, gender, age, occupation and education level
2	Jung & Yoo (2014)	Survey	Ticket price, Access time to travel mode, service frequency, travel time
3	Wang et al. (2014)	Survey	Occupation, income, travel purpose, transport type to travel mode (on foot, by bus, automobile), travel time, travel cost, distance
4	Valdes, V. (2015)	Panel data	Gross domestic product per capita (GDPpc), net flows of foreign direct investment (FDI), consumer price index (CPI), real Exchange rate (US Dollar), jet fuel price, total number of seats offered by LCCs, number of years the country has been under deregulation, the year countries join the European Union, average distance between each country
5	Hess et al. (2018)	Survey	Gender, education, unemployment statistics, travel purpose, whether or no somebody accompanying travel, time spent at destination point, daily service frequency, travel time from first point / travel mode to end point, journey time on route, travel cost, attitude towards travel mode
6	Boonekamp et al. (2018)	Cross-sectional data	Gross domestic product (GDP), population, employment rate in aviation-related sectors, the number of foreign overnight stays in hotels, ethnicity (citizenship between two cities), flight frequency, number of non-stop flights from the airport, distance, share of low-cost carriers on the route, number of routes subject to public service, average ticket price of airlines serving the route, passenger demand between airport pairs
7	Zhou et al. (2019)	Survey	Travel cost, access time to airport, journey time, seat comfort, travel frequency

3. METHOD

The research was designed with the relational screening approach, which aims to determine the existence of co-variation between two or more variables. Correlation and comparison also fall within this category (Karasar, 1984: 83).

The model developed with the variables thought to affect the transition from alternative transportation modes to air travel is given below;

V_j = Constant + β1 Travel cost + β2 Access & Egress Time + β3 Total travel time + β4 Prestige + β5 Purpose of the trip + β6 Age + β7 Marital status + β8 Frequency + β9 Occupation + β10 Household income + β11 Ease of Access + β12 Non-stop flight + β13 Special offers for early purchase.

3.1. Stated Survey Preference (SP) Design

While preparing the survey questions, the scales provided by Temurlenk (1991), Seo and Kim (2003), and Yaylalı and Dilek (2009) were used. The questions that were rather ambigous to a selected group of participants within the survey were eventually revised after the pre-application (pilot study) in the provinces.

The questionnaire consists of four parts. In the first part, questions regarding demographic information were included. The second part covered questions regarding the participants' choice of transportation type and the reasons for their preference, followed the third part related to travel behaviors. In the final part, statements about the factors affecting the transition to air transportation were included. A 5-point Likert-type scale was applied (1. Strongly disagree, 2. Disagree, 3. Undecided, 4. Agree, 5. Strongly agree). The questionnaire items appear in Table 2. While preparing the statements, expert opinions and similar studies in the literature were used (Temurlenk, 1991; Seo & Kim, 2003; Yaylalı & Dilek, 2009).

Table 2. Survey Items Concerning the Factors Affecting Switching to Flight

No	Statements
1	I prefer using the plane even if it cuts the same price as the bus.
2	If the flight tickets are even twice as expensive as the bus's, I still prefer the plane.
3	If the flight tickets are even three times as expensive as the bus's, I still prefer the plane.
4	I think traveling by plane brings one respect.
5	I prefer the plane on the condition that there is easy transportation between the airports and the city center.
6	I prefer the plane if the fees charged for excess baggage are reasonable.
7	I prefer the plane if the flights to my destinations are non-stop.
8	I prefer the plane if the time it takes to claim my baggage is reasonable.
9	I think that traveling by plane is preferred by people with status.
10	I prefer the plane only if the flight days and times are suitable for me.
11	I prefer the plane if it takes shorter to travel from my home/workplace to my destination.
12	I think traveling by plane is prestigious.
13	I prefer the plane if there are special offers.

In the analyses, the first statement appears as "The same price," the second statement as "2 times the price," the third as "3 times the price," the fourth as "Respectability," the fifth as "Ease of access to airport," the sixth as "Excess baggage fee," the seventh as "Non-stop flight," the eighth as "Time to claim luggage," the ninth as "Status," the tenth as "Flight time convenience," the eleventh as "Total travel time," the twelfth as "Prestige," and the thirteenth as "Special offers for early purchases."

3.2. Study Area and Sample

The sample group consists of individuals residing in the provinces of Kayseri and Bursa. According to the 2018 census, the population of Bursa was 2,994,521. In 2019, it increased by approximately 2.1% and reached 3,056,120, followed by3,101,833 in 2020 Bursa is the fourth most populous province in Turkey; its share in Turkey's gross domestic product is 4.2%, and it also ranks fourth in terms of GDP. The population of Kayseri was 1,389,680 in 2018 and increased by approximately 1.3% in 2019 and reached 1,407,409, followed by 1,421,455 in 2020. It ranks fifteenth

in terms of population nationwide. Its share in Turkey's GDP is 1.4%, and it ranks thirteenth in the country. In 2019, while the per capita GDP in Bursa was $10,382, it was $7,785 in Kayseri. Both provinces are considered important trade, industry, and tourism hubs (TÜİK, 2021). The distance between the two provinces is 668.2 km, taking about 8 hours by car. There are daily bus services between the two provinces, with travel times up to 10 hours. Express bus service is not available, but there are train services with transfers.

The Kayseri Erkilet Airport is 5 km from Kayseri province center. It is possible to reach the airport from the province center by bus, taxi and ground passenger services. The Bursa Yenişehir Airport, on the other hand, is 50 km away from Bursa province center, and transportation is done using bus and taxi with no ground passenger services available.

3.3. Data collection

The questionnaires were administered between January and March, 2018. The convenience sampling method was used in sample selection. Considering that there may be incomplete and incorrect fillings, face-to-face surveying was done with 600 people in both provinces, excluding nonresidents of the through provinces. When the erroneously and inconsistently filled questionnaires were eliminated, the data of 453 individuals in Bursa and 501 in Kayseri were left to evaluate. The sample size included in the analysis is above the quorum of 384 for each province.

3.4. Research Problem

The following questions constitute the research problem: “Is there sufficient demand for reciprocal non-stop flights between the provinces of Kayseri and Bursa?” and “Does the price have a significant effect on the increase in flight demand?”

4. KAYSERI AND BURSA DATA SETS ANALYSIS AND FINDINGS

4.1. Findings of Frequencies, Descriptives, and Factor Analysis

After excluding the data of 41 people in Kayseri and 49 people in Bursa, who had a fear (phobia) of traveling by airplane and who stated that they would never travel by airplane, the survey data of the remaining 460 individuals in Kayseri and 404 individuals in Bursa were analyzed.

Considering the findings of the main variables, 48.3% (222 individuals) of the participants in Kayseri and 33.7% (136 individuals) in Bursa are between the ages of 31 and42. The second-largest participant group is followed by the 19-30 age group with a rate of 29.6% (136 individuals) in Kayseri and 28.5% (115 individuals) in Bursa. While the majority of the participants in Kayseri are university graduates (51.5%; 237), most in Bursa are high school graduates (38.6%; 156). In Kayseri, workers and civil servants grouped under the "non-agricultural workers" are the majority (201 individuals, 43.7%). In Bursa, the majority of the participants gathered under the "professional occupational " group (27% of

109 individuals). In Kayseri, the majority of the participants (24.3%; 112 individuals) stated that they have a household income of more than 6001TL. The majority of the participants in Bursa have a household income of 3001-4000 TL (28.2%; 114 individuals) (Between January 1 and March 31, 2018, when the survey was conducted, 1 dollar equalled 3.85 TL according to the Central Bank of the Republic of Turkey's average exchange rate). Then, the majority of individuals earn a household income in the range of 2001-3000TL in both provinces (Kayseri 20%; 92 individuals, Bursa 28%; 113 individuals).

When the travel behaviors of people residing in Kayseri and Bursa who have the potential to travel by airplane were examined, it was determined that 60.4% of the participants residing in Kayseri have previously visited Bursa, and 71.3% of the participants residing in Bursa have previously visited Kayseri. In terms of the purpose of visit, 41.4% of the participants stated that they traveled to visit relatives/friends, 19.8% for business purposes, and 17.2% for touristic purposes. While 72% of the participants from Kayseri stated that they have the possibility or desire to travel to Bursa in the future, 50.5% of the participants from Bursa stated that they have the possibility or desire to travel to Kayseri in the future. In addition, 72.3% of the participants in both provinces stated that they would prefer the airplane for their journeys to Bursa/Kayseri if there were non-stop flights in the future. The vast majority of the participants, 82.2%, stated that they usually have someone accompanying them on their travels, 70.9% usually pay for their own tickets, 55.7% usually book their tickets from the website, 74.5% make their ticket reservation at least one month in advance, and 89.1% do not have a phobia of traveling by airplane.

The distribution of the participants' preference for the mode of transportation from Bursa to Kayseri is given in Table 3.

Table 3. Distribution of Transportation Mode Preference Between Bursa and Kayseri Provinces

Transportation Mode	**N**	**%**
Bus	258	29.8
Train	10	1.2
Airplane	226	26.2
Personal vehicle	370	42.8
Total	864	100

As can be seen in Table 3, the most preferred mode of transportation for the trips from Bursa to Kayseri and Bursa to Kayseri is the personal vehicle (42.8%), The airplane, however, is the third preferred mode of transportation (26.2%) In both provinces, it was determined that the least preferred mode of transportation was the train. This is considered to be due to the long travel times of the train.

The reliability and validity analyses were made for the statements that measure the conditions under which the participants will switch from alternative modes of transportation to the airplane. The reliability analysis and internal consistency of the statements in the scale were examined by calculating

the most preferred method in the literature, Cronbach's Alpha Coefficient This alpha value consists of 13 items for Kayseri and Bursa provinces, and was found to be 0.890 (0.80>α>1.00), which is highly reliable.

Exploratory factor analysis was carried out to determine the validity of the statements that measure the conditions under which the shift from alternative transportation modes (bus, car, or train) to the airplane is made. The Bartlett's Test of Sphericity and the Keiser-Meyer-Olkin (KMO) test were applied to determine whether the scale is suitable for factor analysis. The KMO value for Kayseri was found to be 0.877, and the KMO value for Bursa 0.881. A KMO value above 0.800 means that the scale is perfectly suitable for factor analysis (Yaşlıoğlu, 2017: 75-76). The Bartlett test, on the other hand, reveals the statistical significance of the correlation matrix and the Bartlett's value is statistically significant since p: .000<0.05, meaning that the scale used in the study is suitable for factor analysis.

In order to obtain interpretable and meaningful factors, they were rotated. Although it is almost impossible to find unrelated factors in real life, since studies generally aim to find the most appropriate number of independent factors, varimax rotation which is an orthogonal method is generally accepted conventionally (Yaşlıoğlu, 2017: 78). This method was used to rotate the factors in the Kayseri and Bursa data sets. As a result of the analysis, as expected, the measurement expressions are found to be distributed over three factors that measure attitudes about price, convenience, and prestige. The statements gathered under the factors and factor loads for the province of Kayseri are given in Table 4, and those related to Bursa in Table 5.

Table 4. Statements Under Factors and Factor Loadings for Kayseri

Factors	**Statement Sequence Number**	**Statements**	**Factor Loads (Kayseri)**
Price	1.	The same price	.423
	2.	2 times the price	.886
	3.	3 times the price	.871
Convenience	5.	Ease of access to airport	.816
	6.	Excess baggage fee	.817
	7.	Non-stop flight	.845
	8.	Time to claim baggage	.869
	10.	Flight time convenience	.790
	11.	Total travel time	.831
	13.	Special offers for early purchases	.654
Prestigious	4.	Respectabilitity	.866
	9.	Status	.855
	12.	Prestige	.902

Table 5. Statements Under Factors and Factor Loadings for Bursa

Factors	**Statement Sequence Number**	**Statements**	**Factor Loads (Kayseri)**
Price	2.	2 times the price	.902
	3.	3 times the price	.912
Convenience	5.	Ease of access to airport	.851
	6.	Excess baggage fee	.807
	7.	Non-stop flight	.871
	8.	Time to claim baggage	.842
	10.	Flight time convenience	.787
	11.	Total travel time	.821
	1.	The same price	.515
Prestigious	4.	Respectability	.866
	9.	Status	.845
	12.	Prestige	.830

While statement "same price" was thought to be under the "price" factor, it was included under the convenience" factor. The statement "cheap tickets for special offers" was excluded from the analysis because it was included under both "convenience" (factor load 0.595) and "price" (factor load 0.505) factors, and the difference between the factor loads where less than 0.10.

The mean scores of the responses given to the statements under the factors for Kayseri and Bursa are given in Table 6.

Table 6. The Average of The Responses Related to Each Factor for Kayseri and Bursa

Statements	**Average (I) Kayseri**	**Average (II) Bursa**
2 times the price	4.33	4.43
3 times the price	2.86	2.29
Ease of access to airport	2.32	1.69
Excess baggage fee	2.68	2.80
Non-stop flight	3.33	3.88
Time to claim baggage	3.16	3.70
Flight time convenience	3.55	3.85
Total travel time	3.28	3.66
The same price	2.17	2.93
Respectability	3.14	3.77
Status	3.31	3.85
Prestige	2.94	3.09

As can be seen from Table 6, participants in both provinces (Kayseri 4.33; Bursa 4.43) stated that they would prefer the airplane if it were the same price as the bus. As the price of the airplane ticket increases, the rate of preferring the airplane decreases. The perception that traveling by airplane is prestigious was not as high as expected. The reason for this is, perhaps, that airplanes today are available and affordable for everyone.

Logistic regression is a method that is frequently used to determine the cause-effect relationship with the explanatory (or predictive variables when the response (or predicted) variable is observed in two or more categories. With this method, the effects of explanatory variables on the dependent variables are calculated as probability in the same way thatrisk factors are determined as such (Özdamar, 2004: 589). Before performing the logistic regression analysis, the assumptions that there were no multicollinearity and outliers among the independent variables were tested. Since the VIF values of k independent variables take values between 1 and 5 in the multicollinearity test, it can be stated that there is an acceptable moderate correlation between the variables. For the outlier test, Cook's distance values were checked. The data with absolute values greater than 3 at standard residual values were excluded from the analysis. Therefore, the assumptions for logistic regression analysis are provided.

In order to examine the improvement in the model fit, it started with a -2LL value (Kayseri 443.504; Bursa 505.278) in the iteration story of the initial model established. This rate is considerably higher than the zero (0) value representing perfect fit.

The goodness of fit test of the model (Hosmer and Lemeshow Test) tests the hypothesis below:

"H1: There is significant difference between the predicted values and the observed values."

Since the p_ value is greater than 0.05 in the analyses for both provinces (Kayseri, p.0.314>0.05; Bursa, p.0.980>0.05): this hypothesis is rejected, there is no significant difference between the predicted values and the observed ones.

It can be stated that the predictability of the model is similar to the actual settings. When the effects of demographic variables and factors related to price, convenience, and prestige on the decision to prefer the airplane as a transportation mode from Kayseri to Bursa were investigated, the coefficients of the model were found to be significant ($p=0.000<0.05$). Independent variables contribute to the prediction of the dependent variable. Therefore, the hypothesis (H1) was rejected that there is no difference between the initial model with only the constant term and the intended model formed by the independent variables being included in the analysis. While the -2LL likelihood value was 440,624 for Kayseri in the initial model, it decreased to 254,853 when the independent variables were included in the model. In Bursa, while the -2LL likelihood value was 505,243 in the initial model, it decreased to 397,914 when the independent variables were included in the model. When the variables are included in the model, there is an improvement in the fit of the model. The explanatory power of the model developed for Kayseri was found to be 34.0% according to the Cox-Snell test, and 54.2% according to the Nagelkerke test. The independent variables explain 54.2% of the variance in the dependent variables. Since a a value above 0.3 is acceptable, it can be stated that there is moderate explanatory power, which in the model developed for Bursa was found to be 24.0% according to Cox-Snell and 33.1% according to Nagelkerke.

The classification of the intended models for the Kayseri and Bursa data sets are given in Table 7 and Table 8.

Table 7. Classification of the Model for Kayseri

Observed			Estimated		
			Would you prefer if there is a non-stop flight from Kayseri to Bursa?		Percentage of correct predictions
			No	Yes	
Step 1	Would you prefer if there is a non-stop flight from Kayseri to Bursa?	No	44	43	50.6
		Yes	19	341	94.7
	Average percentage				86.1

Table 8. Classification of the Model for Bursa

Observed			Estimated		
			Would you prefer if there is a non-stop flight from Bursa to Kayseri?		Percentage of correct predictions
			No	Yes	
Step 1	Would you prefer if there is a non-stop flight from Bursa to Kayseri?	No	68	68	50.0
		Yes	32	223	87.5
	Overall percentage				74.4
a. Cut value .500					

Table 7 and Table 8 show the percentage of the model predicting the dependent variable correctly with a 0.500 cut value. As seen in the tables, the model correctly predicted those who preferred the airplane from Kayseri to Bursa at the rate of 94.7%, and those who did not prefer at 50.6%. Also, it correctly predicted 87.5% of those who preferred the airplane from Bursa to Kayseri and 50% of those who did not. Therefore, it can be seen that the model is weak in estimating the "no"s.

Table 9 and Table 10 show the effect of the changes in the model variables developed for the Kayseri and Bursa data sets on the probability of choosing the airplane.

Table 9. Model Variables for Kayseri

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Maritul status (1)	-.297	.419	.500	1	.479	.743	.327	1.691
	age4.1			8.410	3	.038			
	age4.1(1)	-1.817	.873	4.335	1	.037	.162	.029	.899
	age4.1(2)	-2.145	.831	6.666	1	.010	.117	.023	.596
	age4.1(3)	-2.513	.896	7.861	1	.005	.081	.014	.469
	income2			.272	2	.873			
	income2(1)	.205	.439	.219	1	.640	1.228	.520	2.899
	income2(2)	.203	.462	.194	1	.660	1.226	.495	3.033
	education2(1)	1.116	.401	7.745	1	.005	3.053	1.391	6.702
	occupation2			14.127	5	.015			
	occupation2(1)	-.792	.592	1.790	1	.181	.453	.142	1.445
	occupation2(2)	-.533	.544	.962	1	.327	.587	.202	1.703

	occupation2(3)	-1.827	.529	11.944	1	.001	.161	.057	.453
	occupation2(4)	-.551	.483	1.299	1	.254	.576	.223	1.487
	occupation2(5)	-1.848	.912	4.106	1	.043	.157	.026	.941
	The same price	.695	.175	15.794	1	.000	2.005	1.423	2.825
	2 times the price	.283	.210	1.807	1	.179	1.326	.879	2.003
	3 times the price	-.025	.229	.012	1	.912	.975	.623	1.526
	Respectability	-.285	.180	2.519	1	.112	.752	.529	1.069
	Ease of access to airport	-.125	.234	.287	1	.592	.882	.558	1.395
	Excess baggage fee	.480	.232	4.269	1	.039	1.615	1.025	2.546
	Non-stop flight	.912	.259	12.428	1	.000	2.489	1.499	4.131
	Time to claim luggage	-.718	.275	6.820	1	.009	.488	.284	.836
	Status	-.596	.182	10.711	1	.001	.551	.386	.787
	Flight time convenience	.020	.240	.007	1	.934	1.020	.637	1.634
	Total travel time	.080	.239	.111	1	.739	1.083	.677	1.732
	Prestige	.156	.185	.703	1	.402	1.168	.812	1.680
	Special offers for early purchases	.566	.173	10.666	1	.001	1.761	1.254	2.473
	Constant	-4.434	.839	27.895	1	.000	.012		

Table 10. Model Variables for Bursa

		B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
SStep 1[a]	occupation2			5.751	.331			
	occupation 2(1)	-.217	.445	.238	.625	.805	.336	1.926
	occupation 2(2)	.145	.443	.106	.744	1.156	.485	2.754
	occupation 2(3)	-.332	.408	.660	.416	.718	.322	1.597
	occupation 2(4)	.406	.491	.682	.409	1.501	.573	3.932
	occupation 2(5)	-.923	.700	1.738	.187	.398	.101	1.567
	income2(1)	-.219	.304	.517	.472	.804	.443	1.458
	age2.1			.874	.832			
	age2.1(1)	.118	.565	.044	.834	1.126	.372	3.408
	age 2.1(2)	.399	.509	.615	.433	1.490	.550	4.041
	age 2.1(3)	.215	.493	,191	.662	1.240	.472	3.257
	Marital status(1)	-.056	.357	.024	.876	.946	.470	1.904
	Education 2(1)	.604	.377	2.569	.109	.829	.874	3.829
	The same price	.784	.171	20.934	.000	2.190	1.565	3.064
	2 times the price	-.211	.149	2.006	.157	.810	.604	1.084
	3 times the price	.643	.196	10.737	.001	1.902	1.295	2.795
	Respectability	.202	.133	2.300	.129	1.223	.943	1.587
	Ease of access to airport	-.420	.258	2.647	.104	.657	.396	1.090
	Excess baggage fee	-.273	.197	1.930	.165	.761	.517	1.119
	Non-stop flight	1.036	.279	13.826	.000	2.817	1.632	4.864

	Time to claim luggage	-.100	.241	.173	.677	.905	.564	1.450
	Status	-.085	.135	.399	.527	.918	.705	1.197
	Flight time convenience	-.119	.206	.331	.565	.888	.593	1.331
	Total travel time	.243	.202	1.449	.229	1.275	.859	1.892
	Prestige	-.408	.157	6.761	.009	.665	.489	.904
	Constant	-4.034	.793	25.879	.000	.018		

As can be seen in Table 9 and Table 10, it can be said that the parameters of marital status, income, prestige, ease of access to airport, flight time convenience, 2 times the price, and total travel time are insignificant in the models developed for the two provinces, implying that they do not have any effect on the probability of choosing the airplane (odds value). In the model developed for Kayseri province, education level, occupation, age, being the same price as the bus tickets, reasonable excess baggage fare, non-stop flight, time to claim luggage, status, and availability of cheap tickets for early purchases were found to be significant in the model.

Provided that the other variables remain constant, those with a university degree in Kayseri are 3.053 times (205.3%) more likely to prefer the airplane than those with a high school degree or lower. When the likelihood of the condition "The bus and airplane ticket prices are the same" increases by one unit, the probability of preferring the airplane increases by 2.005 times [(2.005-1)*100] 100.5% from Kayseri to Bursa. This rate is 2.19 [(2.19-1)*100] 119% for travels from Bursa to Kayseri. When the non-stop flight status increases by one unit, the probability of preferring the airplane increases by 2.489 times [(2.489-1)*100] 148.9%.

4.3. Artificial neural networks analysis and findings for Kayseri and Bursa

In this section, a model is developed that predicts the probability of choosing a non-stop flight from Kayseri to Bursa and from Bursa to Kayseri with the Artificial Neural Networks (ANN) method. The variables in the estimation model are related to demography and the answers given to the survey questions.

Obtaining the best estimating model with a minimum error rate was done by changing the ratios in the data sets trained and tested in ANN, combining the activation functions in different ways, changing the number of hidden layers, changing the number of cells in the hidden layers, and changing the maximum number of Epochs (iterations). The model structure that makes the best prediction is in the data sets of both provinces, found by using 80% training set and 20% test set, a single interlayer, 20 interlayer cells, 2000 epochs (1000 epochs in Bursa province), sigmoid in the input layer, and softmax activation in the output layer. It is convenient to employ the Sigmoid function when the output is bivariate. The Softmax function produces probability values for the similarity of the test input for each class. The epoch (iteration) number is the number of times the data set has passed through the network. The optimal number of Epochs (iterations) is determined by trial and error. If the error of the network

on the samples falls below a certain value, the training of the network is considered sufficient. By keeping the parameters constant, the data of both provinces were tested 20 times. The arithmetic mean of the overall correct estimation percentage of the test sets of 20 trials for Kayseri province was 81.6%, and the standard deviation was 4.24. Considering the arithmetic mean of the ANN models developed, it was determined that the percentage of correct predictions of “yes” was 95.32% in Kayseri, which is relatively high. On the other hand, it was observed that the success of the ANN model in accurately predicting the “no” answers was very low (34.5%). Also, it was observed that the standard deviation of "no"s is very high at 13.63. This is an undesirable outcome. The arithmetic mean of the ANN models developed for Bursa was 76.94%, and the standard deviation was 5.36. It was observed that the correct estimation percentage of “no” was low (57.78%) in all of the 20 trials, as in the trials conducted for the province of Kayseri. The standard deviation was found to be 18.32. An accurate estimation percentage above 70% is acceptable. In the logistic regression analysis, on the other hand, with the same data set, the success of accurate estimation of no's was 50.6%, the success of accurate estimation of yes's was 94.7%, and the overall accurate estimation percentage was 86.7%. As can be seen, although the ANN model gives more accurate results compared to the logistic regression model in estimating the probability of preferring the airplane in Bursa, both analyses failed to predict the “no” answers at a satisfactory rate. The “no” answers to the question "Would you prefer if non-stop flights are offered to Bursa?" were less than one-third of the “yes” answers. It can be stated that ANN is weak in learning the “no” answer due to the low number of individuals who responded so. of the number of these individuals in the data set was increased by repetitions. In other words, the number of no's was increased 3 times by repeating the data with 89 “no” answers consecutively. In this way, the number of “yes” and “no” answers used to train the ANN was equalized. This is an acceptable approach for ANN, and it is expected to increase its performance.

In the augmented data set, the number of “yes” answers reached 361, and the number of “no” answers reached 275. Provided that the determined parameters remained constant, 20 trials were made with the augmented data set. The percentages of accurate predictions in the test set of each trial, the arithmetic mean, and the standard deviation of the trials are given in Table 11.

Table 11. ANN Final Trial Results for Kayseri

Trials	**No (%)**	**Yes (%)**	**Average (%)**
1	73.8	81.8	78
2	69.2	81.3	75.9
3	67.7	82.1	75.2
4	66.7	86.3	79,.2
5	75.6	76.9	76.4
6	64.3	86.4	76.2
7	66	82.1	76
8	71.4	78.7	75.2
9	72.2	76.2	74.6
10	64	83.1	75.2
11	72.9	87.7	81.1

12	63.9	80.5	73.2
13	70	79.7	75.4
14	62.5	84.7	75.8
15	70.9	82.9	77.6
16	72.7	87.7	81.3
17	67.2	84.9	77.1
18	64.6	81.9	75
19	**73.1**	**89.1**	**81.9**
20	69.5	83.9	76.5
Average	**68.91**	**82.895**	**76.84**
Standard deviation	**3.886400039**	**3.533222027**	**2.366298464**

Table 12 shows the ANN information of the model developed for Kayseri.

Table 12. ANN Network Information for Kayseri

Input layer	Categorical variables	1	marital status
		2	occupation
		3	income
		4	education
		5	age
	Continuous variables	1	The same price
		2	2 times the price
		3	3 times the price
		4	Respectability
		5	Ease of access to airport
		6	Excess baggae fee
		7	Non-stop flight
		8	Time to claim luggage
		9	Status
		10	Flight time convenience
		11	Total travel time
		12	Prestige
		13	Special offers for early purchases
	Number of neurons		30
	Normalization method		Standardized
Hidden layers	Number of hidden layers		1
	The number of hidden neurons		30
	Activation function		Sigmoid
Output layer	Dependent variables	1	Would you prefer if there is a non-stop flight from Kayseri to Bursa?
	Number of nerve cells		2
	Activation function		Softmax
	Error function		Cross entropy

The variables with a normalized significance of less than 35% were considered “ineffective” in determining airline demand, those between 35% and 50% significance were considered “moderately effective”, those between 50% and 70% significance considered “effective”, variables with more than 70% significance were considered “highly effective”, and 100% significant variables were considered “extremely effective”. It was determined that the condition where the bus ticket and the airplane ticket are the same prices is “extremely effective” (with 100% normalized significance) in determining airline demand.

In the augmented data set for Bursa, the number of "yes" answers reached 264 and the number of "no" answers reached 247, making the two figures close. Provided that the determined parameters remain constant, 20 trials were made with the augmented data set.

It was observed that the estimation success of "no" was increased in the trials with the augmented data set. In 20 trials, the arithmetic mean of no's was 75.78%, the arithmetic mean of yes's was 77.77%, and the overall correct estimation percentage was 76.84%. It was observed that the standard deviation of no's has decreased from a large value of 18.32 to an acceptable value of 7.15. The augmented cluster has enabled ANN trials to give more balanced and stable results.

As can be seen in Table 13, the model that made the best estimation within 20 trials is Model 5, with 83% "no", 82.8% "yes", and 82.9% overall correct estimation percentage.

Table 13. ANN Final Trial Results for Bursa

Trials	**No**	**Yes**	**Average**
1	66,1	78,7	71,8
2	78,8	81,8	80,2
3	77,6	77,4	77,5
4	84,5	73,7	79,1
5	**83,0**	**82,8**	**82,9**
6	72,2	71,2	71,7
7	74,1	86	79,8
8	80,4	82,2	81,2
9	73,5	80,3	77,3
10	74	76,6	75,3
11	61,5	66,7	64,2
12	76,6	76,9	76,8
13	88,5	71,4	80,9
14	70,4	80	75,2
15	87,8	76,1	81,6
16	78,7	81,5	80,2
17	68,1	78,6	73,8
18	77,8	79,2	78,5
19	75,4	75,9	75,6
20	66,7	78,4	73,3
Average	**75,785**	**77,77**	**76,845**
Standard deviation	**7,158526**	**4,528169**	**4,440777**

Table 14 shows the network information of the Model 5, which made the best predictions.

The significance levels of Model 5 variables that make the most accurate estimation are given in Table 14.

Table 14. The Significance Levels of Model 5 Variables for Bursa

	Model 5			
Variables	**Significance**	**Normalized Significance**	**Trials averages**	**Standard deviation**
Marital status	.009	5.7%	8.8%	0.0317481
occupation	.058	8.5%	12.2%	0.0591905
income	.013	38.5%	32.8%	0.0766859

education	.026	17.2%	17.4%	0.0451804
age	.053	35.4%	26.3%	0.0865427
The same price	**.118**	**79.3%**	**88.5%**	**0.1364115**
2 times the price	.037	24.8%	24.0%	0.0838541
3 times the price	.082	55.3%	54.7%	0.1592703
Respactability	.035	23.3%	25.7%	0.0904272
Ease of access to airport	**.149**	**100.0%**	**76.7%**	**0.1831563**
Excess baggage fee	.076	50.9%	48.6%	0.1569868
Non-stop flight	**.132**	**88.6%**	**83.6%**	**0.2081609**
Time to claim luggage	.035	23.4%	27.2%	0.1166642
Status	.020	13.3%	23.1%	0.099919
Flight time convenience	.058	38.9%	46.0%	0.1695376
Total travel time	.054	36.1%	29.6%	0.1047874
Prestige	.046	30.7%	36.5%	0.1011587

It can be seen that "ease of transportation from the airport" is a highly effective variable (with 100% normalized significance) in determining air travel demand, followed by "non-stop flights" (88.6% significance) and "airplane ticket prices being the same as bus tickets" (79.3% significance) as the second and third most effective factors, respectively.

4.4. Cluster analysis and Findings in Kayseri and Bursa

In this study, the participants were gathered in two clusters. The distribution of the number of individuals by clusters is given in Table 15.

While 75.2% of the participants (346 people) in Kayseri and 58.1% (229 people) in Bursa were gathered in Cluster 2, 24.8% (114 people) in Kayseri and 41.9% (165 people) in Bursa were gathered in Cluster 1.

Table 15. Distribution of Individuals in Clusters for Kayseri and Bursa

		Kayseri			Bursa		
		N	% in total	% in total	N	% in total	% in total
Cluster	1	114	24,8%	24,8%	165	41,9%	40,8%
	2	346	75,2%	75,2%	229	58,1%	56,7%
	Total Invalid	460	100,0%	100,0%	394 10	100,0%	97,5% 2,5%
Total		460		100,0%	404		100%

The clustering model summaries are given for Kayseri in Figure 1 and Bursa in Figures 2 and 3.

Figure 1. Summary of Cluster Analysis Model for Kayseri

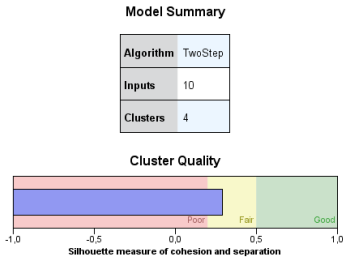
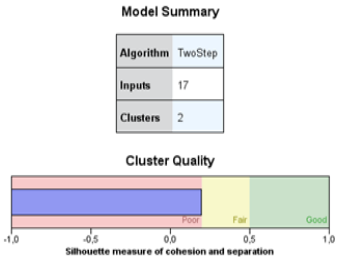


Figure 2. Summary of Cluster Analysis Model for Bursa

Figure 3. Summary of Cluster Analysis Model 2 for Bursa



As can be seen in Figure 1, the model developed for Kayseri has a medium level of cohesion and separation quality with a total of 18 inputs, while the model developed for Bursa has a poor level of cohesion and separation quality with a total of 17 inputs. Status, respectability, prestige, price, and income variables, which were of low significance level, were excluded from the analysis, respectively, and as seen in Figure 3, a moderate level of clustering quality was achieved in the model developed for Bursa.

Figure 4 and Figure 5 show the significance levels of the variables in the demand model.

Figure 4. Significance Levels of the Variables in the Demand Model for Kayseri

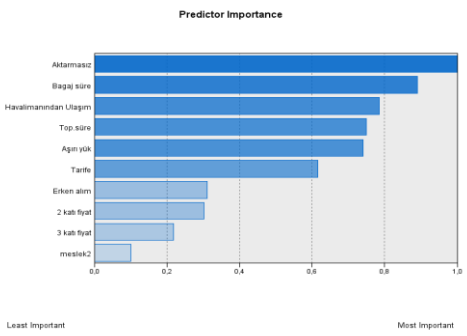
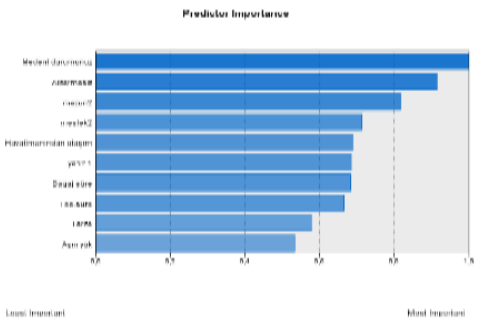


Figure 5. Significance Levels of the Variables in the Demand Model for Bursa



In the model developed for Kayseri, among the factors that affect the preference for transportation by airplane, the following significance levels where observed; "age" (0.01), "marital status" (0.00), "education" (0.10), "income" (0.03), "ease of transportation from the airport" (0.79), "excess baggage fee"(0.74), and "non-stop transportation" (1.00), "time to claim luggage" at 0.89, "flight time convenience" at 0.62, and "total travel time" at 0.75 are the other significant variables in choosing airplanes as a mode of transportation. "Cheap tickets for special offers", "prestige", and "status" variables are of low and negligible significance. In the model developed for Bursa, the "non-stop flight" variable is the most important at 0.92, followed by "ease of transportation from the airport"

at 0.69, "baggage waiting time" at 0.68, "total travel time" at 0.66,, "flight time convenience " at 0.58, and "excess baggage fee" at 0.53.

4.5. Significance of Model Variables According to the Results of Logistic Regression, ANN and Clustering Analysis for Kayseri and Bursa

It is generally accepted that variables with 100% significance in the ANN model are "extremely effective", and those with less than 35% significance are "ineffective". In this study, variables with a significance level of between 35% and 50% were considered "moderately effective" in determining air travel demand, those between 50% and 70% were considered "effective", those between 70% and 99% were considered "highly effective", and those less than 35% were considered "ineffective" In cluster analysis, on the other hand, the variables take degrees of significance between 0 and 1; there 0 is "insignificant", and 1 is "extremely significant". It is generally accepted that variables with a significance level less than 0.40 are "ineffective". Accordingly, variables between 0.40-0.60 significance levels were considered "moderately effective", between 0.60-0.80 were considered "effective", between 0.80-1.00 were considered "highly effective", and variables of 1.00 were considered "extremely effective". As a result of the analysis, some variables were found to be significant in all prediction models, while others were not found significant. Since the ANN model can reflect nonlinear relationships, it is accepted that it gives more precise results than regression and clustering analyses. Table 16 shows the effectiveness of the variables, which are thought to determine the air travel demand, according to all three models.

As a result of the study, it is expected that the demand for air transportation will increase according to all three models if there are non-stop flights in the relevant city pair and/or if the airplane ticket price is reduced to the bus ticket price.

Table 16. Effectiveness of Demand Determiners According to Logit Model, Artificial Neural Networks (ANN) Model and Clustering Analyses Results

	Kayseri Province			Bursa Province		
Variables	Logit	ANN	Cluster	Logit	ANN	Cluster
Age	Effective	Moderately effective	Ineffective	Ineffective	Moderately effective	Highly effective
Marital status	Ineffective	Ineffective	Ineffective	Ineffective	Ineffective	Extremely effective
Education	Effective	Ineffective	Ineffective	Ineffective	Ineffective	Highly effective
Income	Ineffective	Ineffective	Ineffective	Ineffective	Moderately effective	Ineffective
Occupation	Effective	Highly effective	Ineffective	Ineffective	Ineffective	Highly effective
The same price	Effective	Extremely effective	Ineffective	Effective	Highly effective	Ineffective

2 times the price	Ineffective	Moderately effective	Ineffective	Ineffective	Ineffective	Ineffective
3 times the price	Ineffective	Moderately effective	Ineffective	Effective	Highly effective	Ineffective
Respectability	Ineffective	Moderately effective	Ineffective	Ineffective	Ineffective	Ineffective
Ease of Access to airport	Ineffective	Moderately effective	Highly effective	Ineffective	Extremely effective	Highly effective
Excess baggage fee	Effective	Highly effective	Highly effective	Ineffective	Highly effective	Moderately effective
Non-stop flight	Effective	Highly effective	Extremely effective	Effective	Highly effective	Highly effective
Luggage time	Effective	Moderately effective	Highly effective	Ineffective	Ineffective	Highly effective
Status	Effective	Highly effective	Ineffective	Ineffective	Ineffective	Ineffective
Flight convenience	Ineffective	Moderately effective	Highly effective	Ineffective	Moderately effective	Moderately effective
Total travel time	Ineffective	Ineffective	Highly effective	Ineffective	Moderately effective	Highly effective
Prestige	Ineffective	Highly effective	Ineffective	Effective	Ineffective	Ineffective
Special offers for early purchases	Effective	Ineffective	Ineffective	*	*	*

5. CONCLUSION AND SUGGESTIONS

Since the liberalization policy initiated in 2003, domestic air passenger traffic in Turkey has grown rapidly. Despite this rapid growth, today, the majority of domestic passenger transport is still carried out by road. Turkey's large territory, mountainous and rugged terrain in some regions, together with rough winter conditions make it difficult to access some locations by road and alongate the already long journey times. In addition, while air travel to almost every point from the hubs of the airline companies is available, point to point flights between non-hub locations are not sufficient. Flights between these points are only possible by connecting flights although long transfer times on connecting flights reduce the attractiveness of these flights for passengers.

The increase in domestic air transport will provide a comfortable mean of transportation for passengers in addition to time savings. An increase in non-stop flights, will also eliminate the economic differences by contributing to development of interregional tourism and trade in Turkey.

No previous cluster analysis has been found in studies that determine demand criteria for air travel between city pairs. In addition, it is expected that this study will be one of the pioneering studies that apply three methods (regression, artificial neural networks, and clustering analysis) to the same data set.

In this study, the significant variables that are effective in the transition from alternative transportation modes (bus, car, or train) to air travel are determined between city pairs of no hub status and without the non-stop flight option between them, and it was examined how the demand for air transportation will be affected if these variables change. For this purpose, Bursa and Kayseri were chosen as the city pair for the application. In the study in which logistic regression, ANN, and clustering analyses were carried out, it was concluded that, in all three methods, the most significant variables were the availibity of a non-stop flight between the city pair and the ticket price/travel cost. Also, ease of access to airport was found to be significant factor in transition to the air travel in Bursa. It has been observed that the ANN model is more successful against logistic regression analysis and clustering in predicting "no" answers related to the option of non-stop flight. This result supports the studies of Seo and Kim (2003), Sivrikaya & Tunç (2013).

In the study, while 72% of the participants from Kayseri stated that they have the possibility or desire to travel to Bursa in the future, 50.5% of the participants from Bursa stated the same for a travel to Kayseri in the future. Besides, 72.3% of the participants in both provinces stated that they would prefer the air travel for their journeys between Bursa and Kayseri, if a non-stop flight is offered in the future. A non-stop flight between these two provinces will not only reduce the burden of the other main hubs in the country, but will also make a significant contribution to individuals in terms of time and cost. In addition, in terms of easing the air transportation burden of the main hubs, it would be beneficial to increase the number of point to point flights among non-hub airports based on demand surveys in different cities. The present paper is also believed to have a potential to guide the airline companies in their decisions on establishing new routes.

One of the limitations of this study is that it was conducted in only one city pair. It is predicted that conducting the study for more city pairs will generate more meaningful results that can better reflect the general portrait. Another limitation is that time constraints didn't allow for a larger sample size.

In future studies, increasing the size of the samples and including alternative airports as well as the target cities' main airports, and analyzing with different estimation methods is strongly suggested.

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