REPUBLIC OF TURKEY

ADANA ALPARSLAN TÜRKEŞ SCIENCE AND TECHNOLOGY UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF INTERNATIONAL TRADE AND FINANCE

MARKOV CHAINS AND AN APPLICATION ON HOTEL BUSINESSES

Havva KOCABAŞA

MASTER OF SOCIAL SCIENCE

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I hereby declare that all information in this thesis has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all information that is not original to this work.

[Signature]

Havva KOCABAŞA

ABSTRACT

MARKOV CHAINS AND AN APPLICATION ON HOTEL BUSINESSES

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Competition in the tourism sector is increasing day by day, and it is very important for hotel management to know the preference rates of hotels and the factors that affect the preferences, in terms of future marketing strategies. In this sense, determining the preference rates of hotels and their reasons is one of the issues that hotel managements prioritize strategically. The aim of this study is to determine the preference probabilities and the factors affecting preferences of 4 and 5-star hotels with beaches in Mersin province. Firstly, the data of the study were obtained from 410 randomly selected people. After the data were obtained, the study was divided into two parts. In the first part, the preference probabilities of the hotels for the next period and the preference rates of the hotels in the long term were estimated by using the Markov chain method. These estimates were based on considering the current hotel where the participants stayed or if any, the last hotel they stayed. In the second part of the study, the underlying reasons for hotel preferences were determined by using the Hidden Markov model. According to the empirical findings obtained from the first part of the study, the three most preferred hotels in the long term are Ulu Resort Hotel (5*), Liparis Resort Hotel & Spa (5*) and Wonasis Resort & Aqua Hotel (5*), respectively. According to the results of the analysis made in the second part, among the factors affecting the hotel preferences, it was observed that the most important factors affecting the hotel preferences are location, room and facility cleaning, availability of facilities for families with children, and the effectiveness of recommendations/advertisements. It is thought that the results obtained from the study will guide the marketing strategies of the hotels included in the study.

Keywords: Markov Chains, Hidden Markov Model, Hotel Preferences

ÖZET

MARKOV ZİNCİRLERİ VE OTEL İŞLETMELERİ ÜZERİNE BİR UYGULAMA

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Haziran 2021, 70 sayfa

Turizm sektöründeki rekabet her geçen gün artmaktadır ve artan rekabet koşulları içerisinde otel yönetimlerinin otellerin tercih edilme oranlarını ve tercih edilme nedenlerini bilmesi gelecek dönem pazarlama stratejileri açısından oldukça önemlidir. Bu anlamda otellerin tercih edilme oranlarını ve nedenlerini belirlemek otel yönetimlerinin stratejik olarak öncelik verdikleri konuların başında gelmektedir. Bu çalışmanın amacı Mersin ilindeki 4 ve 5 yıldızlı plajı bulunan otellerin tercih edilme olasılıklarını ve tercih edilme nedenlerini tespit etmektir. Öncelikle rastgele seçilen 410 kişiden çalışmanın verileri elde edilmiştir. Veriler elde edildikten sonra çalışma iki bölüme ayrılmıştır. Birinci bölümde katılımcıların hâlihazırda kaldıkları ya da eğer varsa en son kaldıkları otel göz önüne alınarak bir sonraki dönem için otellerin tercih edilebilirlik olasılıkları ve uzun dönemde otellerin tercih edilme oranları Markov zinciri yöntemiyle tahmin edilmiştir. Çalışmanın ikinci bölümünde ise Saklı Markov modeli kullanılarak otel tercihlerinin altında yatan nedenler belirlenmiştir. Çalışmanın birinci bölümünde elde edilen ampirik bulgulara göre, uzun dönemde en çok tercih edilecek üç otel sırasıyla Ulu Resort Hotel (5*), Liparis Resort Hotel& Spa (5*) ve Wonasis Resort& Aqua Hotel (5*)' dir. Çalışmanın ikinci bölümünde yapılan analiz sonuçlarına göre ise, otellerin tercih edilme nedenlerini etkileyen faktörler arasında konum, oda ve tesis temizliği, çocuklu ailelere yönelik imkânların bulunması ve çevredeki kişilerin tavsiyeleri / reklamların etkili olması en önemli faktörler olarak gözlemlenmiştir. Çalışmadan elde edilen sonuçların çalışmaya dâhil edilen otellerin pazarlama stratejilerine yol göstereceği düşünülmektedir.

Anahtar Kelimeler: Markov Zincirleri, Saklı Markov Modeli, Otel Tercihleri

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Havva KOCABAŞA
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NOMENCLATURE

HMM : Hidden Markov Markov

1. INTRODUCTION

From past to present, people tend to tourism activities for reasons such as curiosity, entertainment, rest, desire to see new places and meet new people, participate in cultural and social activities. People have always wanted to move away from the place and environment where they live and to see and experience the natural and historical beauties of other countries or cities and the cultures of the people living there. Tourism enterprises have been established to fulfill the demands and requirements of people when they go to another city or country.

Businesses that fulfill the accommodation, food - beverage, and travel needs of people as a result of their participation in tourism are called tourism enterprises (Maviş, Ahipaşaoğlu and Kozak, 2002, p. 92). One of the most important of these businesses is undoubtedly the accommodation businesses, namely hotels. The history of the accommodation establishments goes back to the inns known to be built in the Ancient Roman period (Dinçer and Dinçer, 1989, p. 45). With the development of technology over time, transportation from one place to another has become easier and thus the value of accommodation businesses has increased. While these organizations were businesses that only fulfill the need for overnight accommodation, today they have turned into businesses that try to meet all the needs of their guests (Akgündüz and Bardakoğlu, 2012, p. 14).

Hotels are businesses that provide the accommodation needs of the customers, and also include auxiliary units for their eating, sports and entertainment needs (Karaman, 2016, p. 13). In its present meaning, the first hotel was opened in London, England, and later hotels continued to be opened in various countries of America and Europe (Kozak, 2002 as cited in Kaya, 2019, p. 5). With the emergence of the hotel chain concept in 1908, hotels with the same name spread rapidly all over the world in the 20th century (Dinçer and Dinçer, 1989, p. 46).

As a result of globalization, the disappearance of economic borders and the increase in competition have changed the market conditions. This situation has led to an increase in product variety and consequently the continuous renewal of consumer expectations. Hotel businesses with very different concepts and designs have started to appear in order to meet the expectations and demands of consumers (Yeşiltaş, Cankül and Temizkan, 2012, p. 194). Hotel businesses meet the demands and needs of their customers in the best way and develop strategies so that their next choice is their own hotel.

It is very difficult to survive for a business that does not know the reasons affecting the hotel preferences of potential customers (Akgündüz and Bardakoğlu, 2012, p. 16). Therefore, when determining their marketing strategies, hotels should analyze the reasons affecting the hotel choosing of customers.

Hotels are customer-oriented organizations, so their continuity depends largely on providing customer satisfaction. Hotels that want to achieve their marketing goals should take into account the demands and requirements of their customers and maximize their service quality. This ensures customer satisfaction and increases customer loyalty to the hotel.

1.1. Hotel Businesses in Turkey

In the modern sense, the first hotel in Turkey was opened in 1841 in Istanbul (Bulut, 2017, p. 13). Istanbul was followed by Ankara and other Anatolian cities, respectively. Hilton Hotel and Divan Hotel came into operation in the 1950s in Turkey and after that Turkey's hospitality industry has shown rapid development and has come to the present situation today (Yurtlu, 2019, p. 1098).

The table below shows the development of the accommodation sector in Turkey over the years.

Table 1. 1. Development of Accommodation in Turkey

PERIOD/ YEARS	DEVELOPMENTS
795	Ribats, one of the first examples of caravanserais, were built.
1019-1020	Ribat-ı Mahi was built by Sultan Mahmud of Gazne.
1229	Sultan Inn was built.
1892	Pera Palas Hotel the first hotel in a modern sense in Turkey was built by the Wagon-Lits company in Tepebaşı, Istanbul.
1914	The Tokatlıyan Hotel in Beyoğlu, Istanbul, was considered as one of the luxury hotels of that period in Europe and the Middle East.
1931	Istanbul Park Hotel was put into service.
1936	Yalova spa restructuring work began.
1950	An agreement was reached between the government of the Republic of Turkey and the Hilton Hotel company to open a hotel in Istanbul.
1951	A hotel construction agreement was signed between the Pension Fund and Hilton Hotels.
1955	Istanbul Hilton Hotel was put into operation.
1955	T.R. Tourism Bank Inc. was established to provide financial support to the tourism sector and to establish leading tourism businesses.
1956	Divan Hotel was put into service.
1957	Kilim Hotel was put into service.
1958	Emek Inşaat ve Işletme Inc. started hotel management.
1961	Ankara Hotel Management High School started education.

Table 1.1. Continued

1963	The Ministry of Tourism and Promotion was established.
1966	Taksim Otelcilik Inc. was established.
1966	Ankara Dedeman Hotel, the first chain of Dedeman Hotels, was put into operation.
1968	Öküz (Ahmet Paşa Caravanserai) in Kuşadası was put into operation by the French holiday village chain Clup Mediterrane.
1970	Martı Holiday Village was put into service.
1976	İnler -Continental hotel chain started hotel management in Taksim, Istanbul.
1982	The Ministry of Culture and Tourism was established.
1983	The Tourism Incentive Law No. 2634 entered into force.
1989	The Ministry of Tourism was established.
1989	Turban Tourism Inc. was established.
2007	The touristic bed capacity in Turkey reached 787,029.

Source: Nazmi Kozak et. al (1995) , Nihat Demirtaş (2010)

1.2. Classification of Hotels in Turkey

All hotels and all other touristic facilities in Turkey are under the Ministry of Culture and Tourism of the Republic of Turkey. The Ministry of Culture and Tourism is the legal authority that determines and inspects the operations, minimum qualifications, standards, licenses, classifications of hotels. In the Tourism Encouragement Law and the Regulation on Certification and Qualifications of Tourism Facilities, the qualifications, segmentation, definition and minimum qualifications of the facilities in Turkey are determined. According to the regulation in question, hotels are divided into five groups as one, two, three, four and five stars (Presidency of the Republic of Turkey Legislation Information System, 2021).

Qualifications that 1-star hotels must carry;

- At least ten rooms,
- Except for facilities that are kept open only during the summer season, windshield, air curtain, revolving door or similar arrangement at the entrance,
- A reception hall consisting of a reception and a lobby with sufficient capacity and comfortable seating facilities,
- Breakfast office and breakfast room (if there is a sufficient size living room or restaurant, these places can also be used for breakfast, a part of the hall used for this purpose in summer facilities may be open),
- Management room,
- Customer elevator proportional to the hotel's capacity, in case the number of floors to be going down or up by the customer is more than three,
- Buffet service between 06:00-24:00,
- Cabinet with first aid supplies and equipment,
- Telephone service in rooms with direct connection to the outside,
- Safes for valuables in number to serve at least 25% of the number of rooms,
- Covering the floors of general spaces and bedrooms completely
- Qualified materials such as carpet, ceramic, parquet.

Qualifications that 2-star hotels must carry;

- Required conditions for 1-star hotels,
- Air conditioning system in general areas according to climatic conditions,
- Office or cupboard for housekeeping on the bedroom floors,
- Hair dryer in rooms,
- Beverage service in rooms.

Qualifications that 3-star hotels must carry;

- Required conditions for 2-star hotels,
- Air conditioning system in rooms according to climate conditions,
- A living room with a seating capacity of 25% of the number of beds, arranged separately from the lobby,
- An additional management room,
- TV in rooms,

- Having a mini bar in 50% of the rooms and suitable service materials for the existing food and beverage types,
- Swimming pool or second class restaurant or cafeteria or multipurpose hall for at least 50 people with an area of at least 1.2 square meters per person,
- Laundry and ironing service,
- Making reservations by computer,
- Twenty four hour buffet service.

Qualifications that 4-star hotels must carry;

- Required conditions for 3-star hotels,
- Telephone booths in the reception hall,
- If the number of floors where customers go up or down is more than two, a customer elevator in proportion to the hotel's capacity
- In the rooms; bedspread, minibar, safe for valuables,
- Room service between 06:00 and 24:00,
- Dry cleaning and tailor service,
- Floor office arrangement on each floor,
- Store,
- Reading area where documents such as periodicals and books in various languages are located,
- First class restaurant serving 50% of the bed capacity of the facility, provided that its capacity is not less than a hundred people,
- Continuous doctor service and infirmary, informing customers about this,
- Sufficient size of luggage room and left-luggage service in this area,
- Service ladder or elevator,
- Trained personnel as much as 15% of the number of personnel,
- The administrative staff must be trained or have at least five years of experience,
- Workplace for office services such as telephone, fax, computer with internet connection,
- The system of leaving a message in the rooms or providing services for it,
- Multi-purpose hall for at least one hundred people, with a minimum area of 1.2 square meters per person,

- Outdoor and indoor swimming pool,
- Indoor hall for cabaret, theater and cinema events with a capacity of at least a hundred people,
- A conference hall with a capacity of at least 100 people per person, with an area of at least 1.2 square meters, at least two study rooms connected to the hall, secretariat and simultaneous translation services,
- A separate hall with a minimum of 1.2 square meters per person, providing a nightclub, discotheque or similar entertainment opportunity for at least one hundred people,
- Providing at least forty square meters of equipment gymnastics, aerobics or billiard hall, sauna with alarm system, Turkish bath, mini golf, tennis or volleyball court, trampoline, bowling hall, go-kart track, ski and sea sports, squash hall or similar facilities at least three of the units,
- A hall for at least a hundred people serving cake and drinks, a separate restaurant serving a la carte serving of at least five hot and cold dishes and desserts from Turkish cuisine, at least three of the cafeteria and snack bar units.

Qualifications that 5-star hotels must carry;

- Required conditions for 4-star hotels,
- At least 120 rooms
- Customer elevator in proportion to the hotel's capacity (if the number of floors where customers go up or down is more than one)
- In the rooms; desk, central lighting switch and socket at the bedside, dressing mirror,
- In the rooms; At least ten materials with emblem such as bathrobe, dental cleaning kit, disposable slippers, sewing kit, shoe wiper, polish, shower foam, make-up cleaning cotton, box tissue paper, umbrella,
- In bathrooms; bathtub, telephone connected with reception, magnifying mirror,
- Non tobacco-smoking room arrangement of at least 5% of the room capacity, not less than six rooms,
- Twenty-four hour room service,
- Garage or covered parking, twenty-four-hour staff in these places,

- In the rooms; providing internet access at the rate of 10% of the number of rooms with satellite or video broadcasts,
- Hairdresser for male and female,
- Stores,
- Trained personnel as much as 25% of the number of personnel,
- à la carte restaurant,
- Providing services such as customer relations and consultancy by experienced personnel in a separate place from the reception,
- Telephone connected to reception in floor corridors.

Mersin province was preferred for this study because of being a city with a coast to the Mediterranean and taking attention to its historical and cultural characteristics, as well as its proximity to Eastern Anatolia, Southeastern Anatolia and Central Anatolia region. Mersin is a complete tourism city with beaches, bays, and natural beauties, historical and cultural features belonging to various civilizations. Mersin is an ideal city for summer tourism, especially due to its climatic conditions and location.

Although there are studies in the literature on the reasons for customers' hotel preferences (Emir and Pekyaman, 2010; Akgündüz and Bardakoğlu, 2012; Yeşiltaş et al., 2012; and Kaya, 2019), no study has been found to predict their next preferences. In this study, the preference probabilities of 4 and 5-star hotels with beaches in Mersin province for the next summer term were determined by the Markov chain method, and the underlying reasons for these preferences were examined with the Hidden Markov model.

The aim of this study is to determine the preference probabilities and the factors affecting preferences of 4 and 5-star hotels with beaches in Mersin province.

1.3. Literature Review

When the literature was examined, no study has been found to predict the next hotel preferences. However, there are many studies aimed at determining the factors affecting hotel preferences. At the same time, when the studies using the Markov Chains method and Hidden Markov model were investigated, it was established that the method and the model are used in various fields, but no study has been encountered in which the Markov Chains method was used in the prediction of subsequent hotel preferences and Hidden Markov Model were used in the analysis of the factors affecting these preferences. From these points of view, this study is the first to determine the next hotel preferences by using the Markov Chains method and the reasons for these preferences by using the Hidden Markov model. In the literature review, firstly, some studies on hotel preferences are given below, and then the studies on preference analysis using the Markov Chain method and Hidden Markov model are mentioned.

Lewis (1985) argued that regression analysis can reveal the main reasons for choice of hotels. Therefore, he investigated hotel choice behaviors of business and leisure travelers and related reasons by using the regression analysis. He compared business and leisure travelers' hotel choice reasons both before staying at a hotel and while staying at a hotel. The study shows that before staying at a hotel, services quality is most important factor for business travelers while the most important factor is the quietness of the hotel for leisure travelers, and business travelers attach importance to security whereas leisure travelers attach importance to services quality while staying at a hotel.

Wong and Chi-Yung (2002) identified the factors affecting the hotel preferences of tourists coming to Hong Kong from other countries. They applied face to face questionnaire method to 300 people from 20 hotels within a six weeks period. As a result of the findings obtained from the survey, they determined that the most important hotel features sought by all participants are respectively price, star rating, location, reputation and room type. However, when they divide participants into two groups as business and leisure travelers, it is seen that business travelers' hotel selection attributes different from leisure travelers.

Yavaş and Babakuş (2005) examined the hotel preferences attributes comparatively between business and leisure travelers. For these reason they used factor analysis and the factor congruency technique. According to the result of the study, it was revealed that the harmony of hotel preferences attributes between business and leisure travelers is weak.

Emir and Pekyaman (2010) determined what factors families with small children pay attention to when choosing the hotel for their holiday. They applied questionnaire method to 514 parents from the city of Afyonkarahisar and used T-test, Variance Analysis and Duncan test for the determination of results. As a result of findings, it was found that security, hygiene, suitable bad for children and availability of kids menus at restaurants of hotels are important factors for the parents with small children in hotel choice.

Baruka and Civre (2012) aimed to determined segments of international travelers based on their decisions in hotel selection for marketing strategies of hotel managements. Data of the study were collected from the hotels guests on the Slovenian coast. According to results of the findings obtained from the survey, they divided hotel guests into four segments as representatives of self and others’ opinion, the ones who trust advertising, guests who all verify, hotel product oriented.

Akgündüz and Bardakoğlu (2012) investigated the reasons affecting the hotel selection based on gender and educational background sought by leisure travelers. They applied the scale developed by Sohravi et al. to 166 people living in Izmir province. As a result of the analysis, it was revealed that the people participating in the study attach more importance to the price and service quality. Furthermore, it was found that female tourists attach more importance to room cleaning than male tourists, people with postgraduate education attach more importance to service quality when choosing a hotel than people with other education levels, and male tourists with bachelor degrees attach more importance to the price factor than women with a same education degree.

Yesiltaş et al. (2012) investigated whether religious beliefs of local travelers affect their hotel choices. For these reason, they applied questionnaire method to 600 local travelers who had stayed an Islamic hotel and a classic hotel. As a result of the study, it was determined that people who regularly obey religious orders prefer Islamic hotels, while those who regularly do not obey religious orders prefer classical hotels, and it was revealed that there is a significant link between people's attitudes towards religious orders and their choice of hotels.

Uçak (2013) examined the influence of internet advertising on hotel preferences. In the study, data were collected from people staying in hotels in Balıkesir province using questionnaire method. As a result of the analyses, it was found that the hotels' internet advertising influence hotel preferences of the people who participate the survey adversely. However, ıt was also revealed that features of the hotels’ internet advertisement and its informational content can positively change the people’s attitudes on hotel preferences.

Murphy and Chen (2014) argued that various comment features on the internet are important in hotel selection. Therefore, five features were identified as star ratings, comment ratings, number of comments, comment variation, and charge of a hotel for the study. A survey was applied to 60 participants to better understand the five attributes in hotel selection. As a result of the findings obtained from the survey, the comment rating feature was found to be the most important feature in hotel selection, while the charge of a hotel was found to be a less important one.

Verma and Chandra (2016) aimed to identify the factors affecting hotel guests' intention to stay in green hotels and participate in green programs while staying at a hotel. Data of the study were obtained from 168 people staying in the hotels located in India. As a result of the analysis, it was identified that energy-saving light bulbs in hotel rooms, recycle bins in hotel lobby and rooms, and green certification of hotels are positive factors, while towel reuse program, refillable shampoo and bed linen change program on request are negative factors affecting customers' hotel preferences.

Yıldırım, Sünnetçioğlu and Atay (2018) aimed to determine whether the lifestyle of consumers is an important factor in choosing green hotels or not. Data of the study were collected from 216 academicians by using the questionnaire method. According to results of the findings obtained from the survey, ıt was revealed that the tendency of hotel customers to choose green hotels depends on their lifestyle, and people with children tend to choose a green hotel more than those who do not have children.

Kaya (2019) examined the factors that affect the hotel preferences of business travelers. For this purpose, data were collected from 267 participants who had visited the city of Mardin for business trips, and the statistical data analysis tool SPSS was used for analysis. As a result of the study, it was determined that the most important factor affecting the hotel selection of business travelers is hygiene followed by bed comfort, room prices and free internet connection.

Wiastuti and Lestari (2020) aimed to investigate the hotel choices of Indonesian Generation Z based on their educational background and demographic information. According to the results of the study, Indonesian Generation Z prefers to stay at local hotels rather than well-known hotels all over the world and to make reservations through online travel companies instead of directly booking hotels. While the most important hotel features that high school or university students look for are hygiene and safety, for the generation Z with a diploma, room comfort and hygiene are the most important features they seek in a hotel. In addition to the findings of the study, it was revealed that demographic differences of Generation Z are a factor affecting hotel choices.

The literature review on consumer preferences and studies conducted to determine the reasons for these preferences using the Markov Chain method and the Hidden Markov model is briefly summarized below.

Styan and Smith Jr (1964) conducted a study to determine whether the Markov Chain method could be used in market research or not. Laundry soap and detergent brand choices of housewives were analyzed using Markov Chain method in the study. 100 housewives in England were asked about the brand of laundry soap and detergent they used weekly during the 6 months period. Markov transition probability matrices were created weekly. The results were compared with the collected data, and the research showed that market distribution during the period and the results obtained from the Markov Chain method were almost equal.

Ertuğrul and Aytaç (2007) used the Markov chain method to determine the relationship between customer needs and technical needs. For this purpose, probability and transition matrices that form the basis of the Markov chain method were used to determine the wishes and needs of car owners for a particular car brand. As a result of the analysis, it was recommended that the automobile industry should give more importance to the design and safety of the vehicle.

Can and Öz (2009) estimated the users' next cell phone brand preferences and the reasons for these preferences by using the Hidden Markov model. The data of the study were obtained from students studying at public universities in Istanbul. The result of the analysis shows that the most important reason why a mobile phone brand is chosen by users is that it has more advanced features than other mobile phone brands.

Alp and Öz (2009) used the Markov Chain method to examine laptop users' next branding preferences. A survey was conducted with 1068 people, and they were asked about the laptop brand they currently use and they used before. The transition matrix, which is the foundation of the Markov Chains method and equilibrium (fixed) vector were created.

Soykan (2010) attempted to show how brands can benefit from Markov Chain technique while making market share estimates. Therefore, it has implemented a study in the automobile tire market. First, the brands in the market were determined in the study. Then, a questionnaire was applied to 400 people about the selected brands. As a result of the analysis, the market shares of the brands for the future periods were determined.

Uslu and Cam (2014) used the Markov Chain method to investigate the sports shoe brand loyalty of students studying at universities in Istanbul. 11 brands were selected for the study and 531 students were asked about the next and current brand preferences among selected brands. The Markov transition matrix and an equilibrium (fixed) vector were created with the obtained data. The results of the study indicated that university students are loyal to the brands they currently use, and the brand preferences of university students become dense on 2 sports shoe brands.

Arıtan and Akyüz (2015) used the Markov Chain method to measure the brand loyalty of automobile users and to determine the automobile brands they will use in the future. The data of the research were obtained from automobile users living in Gümüşhane. Markov transition probability matrix and equilibrium vector were formed with the obtained data.

Yavuz and Karabulut (2016) measured cell phone brand loyalty of students studying at Erzincan University and predicted the brands they will use in the future by using the Markov Chain method for the marketing strategies of mobile phone brands. A total of 520 students, which are 278 female and 242 male, was asked about the mobile phone brand they currently use and they used before. The Markov transition matrix was created by considering the number of transitions from one mobile phone brand to another. With the help of the matrix, brand loyalty and brands that students could prefer in the future were determined.

Şentürk and Alp (2016) used the Markov Chain technique to analyze users' mobile operator and internet service provider preferences. The data of the study were obtained from university students living in Istanbul and their families. As a result of the analysis, the mobile operator and service provider that users will prefer in the long term and brand loyalty of the users were determined.

Danış (2016) identified the factors affecting e-commerce sites preferences of consumers. In the study, academicians were selected as consumers, and websites, where academicians can buy books, were preferred as e-commerce sites. The Hidden Markov model was used to determine the reasons for preference. As a result of the study, it was discovered that the academicians mostly paid attention to the variety and price of the books when choosing the e-commerce site where they could buy books.

Bairagi and Kakaty (2016) analyzed the beverage brand preferences of consumers using the Markov Chain method. In the study, the next period of market share was estimated for 5 different beverage brands, and the brand loyalty of consumers was measured.

Öztemiz and İplikci (2017) aimed to determine the smartphone preferences of the first-year students in a university using the Markov Chain method. The data of the research were obtained from first-year students of Celal Bayar University International Trade and Banking and Finance Department. As a result of the attained data, the transition probability matrix, which is the foundation of the Markov Chain method and the long-term equilibrium vector were formed.

Kıral (2018) analyzed the mobile operator brand preferences of users. Markov Chain method was used for analysis. 750 people living in Adana were asked about their mobile operator brand preferences. According to the data obtained from the survey, the possibilities of transition from one operator brand to another and how much of which operator brand will be selected in the long term were estimated.

Ayaz and Alp (2018) determined the reasons affecting mobile operator preference of students studying at universities in Istanbul by using the Hidden Markov model. The first two basic problems of the Hidden Markov model are used in the study. As a result of the analysis, network coverage power and price were found to be the factors affecting the mobile operator preferences of users.

Dönmez and Alp (2019) examined the sportswear brand preferences of university students and the reasons for these preferences using the Hidden Markov model. The data of the study were obtained from students studying at Yıldız Technical University. The first two basic problems of the Hidden Markov model are used for analysis. As a result of the study, it was determined that the most important reason for choosing a sportswear brand among university students is fabric and design.

Jodinesa, Sutopo and Zakaria (2020) used the Markov Chain method to estimate the market share of electric motorcycles that could reduce pollution to some extent in Indonesia. The data of the study were collected from 100 people who live in Surakarta province. The Markov transition matrix was created with the collected data. As a result of the study, it was determined that the people living in Surakarta reacted positively to the transition to electric motorcycles, and the demand for electric motorcycles would reach a state of equilibrium in the third period.

In the first part of the thesis study, detailed information is given about the development of hotel businesses from history to today and the situation of hotel business in Turkey, and a comprehensive literature review consisting of national and international studies in the field is presented. In the second and third parts of the study, Markov chains and Hidden Markov models, which are the methods used in the thesis, are introduced in detail. In the fourth chapter, an application on hotel businesses is given and the findings are presented, and the results and suggestions are given in the last part of the study.

2. MARKOV CHAINS

In decision-making problems, it is common to encounter situations where the expected cases or the probability of cases cannot be determined. Since the scientific decision-making process is based on models, in such situations, the case is converted into a mathematical model and its variables are defined by probability calculations (Öztürk, 2004; as cited in Öz, 2009, p. 7).

Classical probability theory has generally dealt with independent trial processes, and it has been seen that the possible outcomes for each experiment are the same and occur with the same probability (Gringstead and Snell, 2012, p. 405). Modern probability theory, on the other hand, is concerned with the processes by which past events affect future events. These studies are based on the idea that future events are affected by the consequences of past events.

As a result of this expansion in probability theory, A.A. Markov developed a mathematical model named after him. The purpose of this model is to calculate the probability of any future event by examining only the current situation independent of past events (Eroğlu, 1986, p. 5).

The basis of the Markov Chain method is based on A.A. Markov's mathematical explanation of the structure and behavior of gas molecules in a closed box known as Brownian motion. The first correct mathematical structure of the Markov Chains method was created by N. Wiener in 1923.

The Markov Chain method is used in systems that have a probabilistic transition from one state to another over time. The transition from one state to another does not depend on past events, but only on the current event. Because of this feature, it will be sufficient to know the current situation of the system in order to apply the Markov Chain method. Since most systems meet this feature in practice, the Markov Chain method is a very widely used probability model.

For example; Betancourt (1999), Öz (2009), Can and Öz (2009), Akyurt (2011), Özdemir and Demirelli (2014) in the field of economics, Süt, Türe and Şenocak (2007) in the field of health, Alp (2007), Adam (2015) in the field of education, Özel and Solmaz (2012) in earth science, Özgürel and Kılıç (2003) in meteorology, and Styan and Smith Jr (1964), Arıtan and Akyüz (2015) in the field of marketing made studies using the Markov Chain technique.

2.1. Stochastic Processes

The word stochastic originated from Greek and means random or change. Stochastic processes are sequences of random variables produced by probabilistic laws (Kijima, 2013, p. 1). The theory of stochastic processes essentially comes from the requirement of physicists. It commenced with the study of physical phenomena as random phenomena changing with time (Mehdi, 2003, p. 1).

A stochastic process is a collection of random variables $\{X_t\}$, where t stands for a parameter running over a suitable index set T (Kijima, 2013, p. 1). The process can be written as $\{X_t, t \in T\}$. t denotes time, X_t is the state of the stochastic process at time t and T is the time interval. The parameter set T can be discrete or continuous (Öz, 2009, p. 12). When T is countable, the scholastic process $\{X_t, t \in T\}$ is called a discrete-parameter or discrete-time process, and when Tan interval of the real line, the process is called continuous-parameter or continuous-time process (Medhi, 2003, p. 1). The state space of the process, which is the set of all possible values that the random variable X_t can assume, can be denumerable or non-denumerable just like T (Akyurt, 2005, p. 18). According to this, stochastic processes can be categorized as follows:

- Discrete time and discrete state space
- Discrete time and continuous state space
- Continuous time and continuous state space
- Continuous time and discrete state space (Medhi, 2003, p. 1)

Discrete state processes are called chains. Among the four stochastic processes described above, "discrete-time and discrete-state space" is expressed as discrete-time chain, and "continuous-time and discrete-state space" is expressed as "continuous time chain".

2.1.1. Brownian Motion (Wiener Process)

In 1828, the botanist Robert Brown discovered the irregular movement of pollen, suspended in water, and this irregular movement became known as Brownian motion (Karatzas and Shreve, 1998, p. 47).

Brownian motion is one of the most important stochastic processes. It is used in almost every physical science and in various branches of the social sciences. The first major applications of Brownian motion were made by L. Bachelier and A. Einstein in the fields of finance and physics. N. Wiener established these studies on a mathematical structure (Steele, 2012, p. 29). Hence the Brownian motion is also called the Winer process.

A standard Brownian motion on $[0,T)$ is a continuous-time stochastic process $\{B_t: 0 \leq t \leq T\}$ that satisfies all four conditions below (Steele, 2012, p. 29).

- $B_0 = 0$
- The increases of B_t independent, namely,
  the random variables $B_{t_2} - B_{t_1}, B_{t_3} - B_{t_2}, \ldots, B_{t_n} - B_{t_{n-1}}$
  are independent for any finite set of times $0 \leq t_1 \leq t_2 \leq \cdots \leq t_n \leq T$.
- For any $0 \leq s \leq t \leq T$ the increase $B_t - B_s$ has the Gaussian distribution with mean 0 and variance $t - s$.
- $B_t(\omega)$ is a continuous function of t for all ω in a set of probability.

Brownian motion can be thought of as the limit of a small random walk that the step size is infinite (Önalan, 1996, p. 34).

Let Z be a collection of random variables that takes the values 1 and -1 with the probabilities p and q respectively.

$$X_n = Z_1 + Z_2 + \cdots + Z_n, \qquad n \geq 1,\ X_0 = 0 \tag{1}$$

$$X = \{X_n; n = 0,1,2 \ldots.\} \tag{2}$$

The stochastic process given by equal (2) consisting of a series of partial sums is called the random walk (Önalan, 1996, p. 28).

2.1.2. Independent Increment Process

In the process$\{X_t, t \in T\}$, if the random variables defined below for $t_1 < t_2 < \cdots < t_n$ are independent from each other, the stochastic process$\{X_t, t \in T\}$, is an independent incremental process (Öz, 2009, p. 14).

$$\left(X_{t_2} - X_{t_1}\right), \left(X_{t_3} - X_{t_2}\right), \dots, \left(X_{t_n} - X_{t_{n-1}}\right) \tag{3}$$

2.1.3. Stationary Independent Increment Process

If the increase of $(X_{t+k} - X_t)$ is independent of t in an independent increment process, the process is a stationary independent increment scholastic process. In other words, the stochastic process $(X_t, t \in T)$ is stationary if it has a special unified distribution that is not time dependent, or if the joint distribution of the random variable does not change over time (Dağlıoğlu, 2018, p. 7).

2.1.4. Regenerative Process

A stochastic process $\{X_t, t \geq 0\}$ with state-space $\{0,1,2,\dots\}$ having the property that there exist time points at which the process (probabilistically) restarts itself is known as a regenerative process (Ross, 1996, p. 140-141).

A random time point is known as the Markov point or regenerative point. Once such a point is reached, the past situation of the process does not affect its future in any way (Öz, 2009, p. 14).

2.1.5. Continuous-Time Stochastic Process

A stochastic process can be explained as a family of random variables $\{X_t, t \in T\}$ described on a given probability space and indexed by the parameter t where t various over some parameter space T (Stewart, 1994, p. 4). If the parameter space is discrete, namely $T = \{0,1,2, \dots.\}$, the process is called discrete- time stochastic process; otherwise, if the parameter space is continuous, namely $T = \{t: 0 \leq t \leq +\infty\}$, the process is called continuous-time stochastic process.

A stochastic process is a Markov process, if the conditional probability distribution satisfies the Markov property.

Let X_t represents a continuous stochastic process that indicates the state of a system at time t. The random variable X_t is the state of the process at time t. For $t_0 < t_1$, the random variable X_{t_1} depends on the state of the process at time t_0, namely X_{t_0}. It is independent of previous states. Thus, X_t is considered as the discrete random variables and the structure to be examined is discrete-state continuous-time stochastic processes.

X_t is a continuous-time Markov process, if, for all integers n and for each sequence $t_0, t_1, \dots, t_n$ satisfying $t_0 < t_1 < \cdots < t_n < t$ condition, the equation

$$P\left(X_{t_n} = x_n \middle| X_{t_{n-1}} = x_{n-1}, \dots, X_{t_0} = x_0\right) = P(X_{t_n} = x_n | X_{t_{n-1}} = x_{n-1}) \tag{4}$$

is formed. The future state of the system depends on the present, that is, it is independent of all past states.

2.1.6. Markov Process

Markov process is a stochastic process $(X_t, t \in T)$ if for any $t_0 < t_1 < \cdots < t_n$ the conditional cumulative distributions function of X_{t_n} for given values of $X_{t_0}, X_{t_1}, \dots, X_{t_{n-1}}$ depends only on $X_{t_{n-1}}$ (Ibe, 2013, p. 49). Namely,

$$P[X_{t_n} \leq x_n | X_{t_{n-1}} = x_{n-1}, X_{t_{n-2}} = x_{n-2}, \dots, X_{t_0} = x_0] \tag{5}$$

$$= P[X_{t_n} \leq x_n | X_{t_{n-1}} = x_{n-1}] \tag{6}$$

This means that, the future state of the process depends only on the present state of the process, regardless of the past. This condition is called Markov property, and it was introduced by A.A. Markov (1856-1922) as part of a study targeted at generalizing the classical central limit theorem for independent summands (Karr, 1990, p. 96).

Markov property is that given the present state of the process, the future state is independent of the past states of the process, provided that the state of the process is determined in the Markov process (Alp and Sarıoğlu, 2018, p. 54). Stochastic processes that provide the Markov property are called Markov processes (Ching, Fung and Ng, 2002, p. 187).

Markov processes are categorized according to the essence of the time parameter and the essence of the state space. In terms of state space, a Markov process can be either a discrete state Markov process or a continuous state Markov process (Ibe, 2013, p. 49).

Four essential types of Markov Processes

- Discrete time and discrete state space Markov process
- Discrete time and continuous state space Markov process
- Continuous time and continuous state space Markov process
- Continuous time and discrete state space Markov process

2.2. Markov Chains

In 1906, Andrey Andreyevich Markov formulated Markov Chains and he first used his model to examine spelling of the poem Eugene Onegin written by Alexander Pushkin. Markov reckoned the transition probabilities by itemizing pairs of successive letters (Ames, 1989, p. 175-176).

Discrete time discrete state space and continuous time discrete state space Markov processes are called Markov Chain (Ibe, 2013, p. 49). All states and all t's in the Markov Chain must satisfy the following conditional probability.

$$P(X_{t+1} = j | X_t = i) = p_{ij}\,, \qquad i,j \in S = \{0,1,2,\ldots\} \tag{7}$$

The process starts from one state and transits from one state to another repeatedly. This probability is independent from t. If the chain is in state i at time X_t, then it goes to j with a probability indicated by p_{ij} in the next step, i.e. at X_{t+1}. This possibility does not depend on what conditions the chain was in previous to its current state. The probabilities represented by p_{ij} are called transition probabilities (Gringstead and Snell, 2012, p. 405). p_{ij} is the one-step transition probability. The following equations are valid for p_{ij}.

$$0 \leq p_{ij} \leq 1, \qquad i,j \geq 0 \tag{8}$$

$$\sum_{j=0}^{\infty} pij = 1 \qquad i = 0,1,2,\ldots \tag{9}$$

The matrix formed by the transition probabilities p_{ij}, namely the transition probability matrix of Markov Chains, is indicated by $P = [P_{ij}]$ (Büyüktatlı, İşbilir and Çetin, 2013, p. 2).

For the state space $S = \{0,1,2,\ldots\}$, the transition probability matrix of Markov Chains is written as follows.

$$P = [P_{ij}] = \begin{bmatrix} P_{00} & P_{01} & \ldots & P_{0n} \\ P_{10} & P_{11} & \ldots & P_{1n} \\ P_{20} & P_{21} & \ldots & P_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ P_{n0} & P_{n1} & \ldots & P_{nn} \end{bmatrix} \tag{10}$$

Transition probability matrix elements are calculated by the formula below (Kıral, 2018, p. 41).

$$P_{ij} = n_{ij} / \sum n_{ij} \tag{11}$$

2.2.1. $\boldsymbol{n}$-step Transition Probabilities

The n-step transition probabilities P_{ij}^{n} is the probability that a process in state i will be in state j after n additional transitions (Ross, 1996, p. 167). That is,

$$P_{ij}^{n} = P\{X_{n+m} = j | X_m = i\}, \quad n \geq 0, \quad i,j \geq 0 \tag{12}$$

According to this expression if $n = 1$, $P_{ij}^{1} = P_{ij}$ is obtained. The Chapman-Kolmogorov equations offer a method for figuring these n-step transition probabilities out.

$$P_{ij}^{n+m} = \sum_{k=0}^{\infty} P_{ik}^{n} P_{kj}^{m}, \qquad n, m \geq 0, \quad i, j \geq 0 \tag{13}$$

The above equation is created by observing that

$$P_{ij}^{n+m} = P\{X_{n+m} = j | X_0 = i\} \tag{14}$$

$$= \sum_{k=0}^{\infty} P\{X_{n+m} = j, X_n = k | X_0 = i\} \tag{15}$$

$$= \sum_{k=0}^{\infty} P\{X_{n+m} = j, X_n = k | X_0 = i\} P\{X_n = k | X_0 = i\} \tag{16}$$

$$= \sum_{k=0}^{\infty} P_{ik}^{n} P_{kj}^{m} \tag{17}$$

If $P^{(n)}$ indicate the matrix of n-step transition probabilities P_{ij}^{n}, then equation (13) affirms that

$$P^{(n+m)} = P^{(n)}.P^{(m)} \tag{18}$$

The dot represents matrix multiplication. Therefore, $P^{(n)}$ is calculated by multiplying the matrix P by itself n times.

$$P^{n} = P.P^{(n-1)} = P.P.P^{(n-2)} = \cdots = P^{n} \tag{19}$$

2.2.2. Classification of States in Markov Chains

Classifying the states of a Markov Chain provides convenience to determine the subsequent behavior of the chain (Öz, 2009, p. 22). Definitions are given below.

- If the probability of transition from state i to state j after a certain period is positive, state j is called an accessible state from i (Ibe, 2013, p. 62).
- If states i and j accessible to each other, they are said to communicate and be in the same class. (Ross, 1996, p. 168)
- If every state communicates with every other state, it is said that the chain is irreducible (Stroock, 2005, p. 46).
- If there is a possibility of not returning to the same state after a certain period when starting from state j, a state j is called transient state (Ibe, 2013, p. 64).
- State j is called recurrent, if the process starting from state j, the probability of returning to j is 1 (Kijima, 2013, p. 30).
- If there exists an integer $d > 1$ such that $P_{ij}^{n} = 0$ for all values of n other than $d, 2d, 3d \ldots ; d$ is called the period, a recurrent state j is a periodic state. If $d = 1$, the state j is aperiodic (Ibe, 2013, p. 64).
- The probability of leaving a state is zero $p_{ij} = 0$, or it is impossible to leave a state once it enters, so $p_{ii} = 1$ for $i \neq j$, state i is an absorbing state (Ibe, 2013, p. 64).
- If the states are positive recurrent and aperiodic, they are called ergodic states, and if a chain consists of ergodic states, it is an ergodic chain (Ibe, 2013, p. 64).

2.2.3. Absorbing Markov Chains

Markov Chains can either continue forever or end by absorbing into permanent states. Markov Chain ends when it enters an absorbing state and once the system reaches this state, it can never leave it (Worsham, 2009, p. 3).

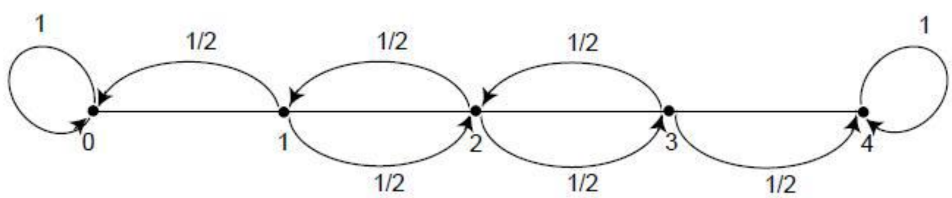

Figure 2. 1. Drunkard’s Path

Source: Grinstead and Snell, 2012, p. 416

What is meant by figure 1 is that the process goes between 4 states. If the process at states 1, 2 or 3, then it can go the other states with equal probability. It continues until the process reaches state 4 or state 0 and it stays there. In this figure, state 4 and 0 are called absorbing states.

In the Markov Chain, the state that cannot be left, once it is entered is called the absorbing state. That is, if $p_{ii} = 1$, the state is the absorbing state. A Markov chain is called the absorbing chain, if it has at least one absorbing state and if it is possible to move somehow to an absorbing state from each state (Grinstead and Snell, 2012, p. 416). Other states, which are not absorbing, are called transient states (Bayrak, 2010, p. 18).

In the analysis of the absorbing Markov chains, the following questions are sought answers (Grinstead and Snell, 2012, p. 416).

- How many times will the process be in each transient state until it was absorbed?
- What is the required number of steps until the process is absorbed?
- What is the probability that the process will end up in a given absorbing state?

For the absorbing Markov chain analysis, the transition matrix is needed to be reorganized. If there are r absorbing states and k transient states in the Markov chain, the transition matrix will have the following form:

$$P = \begin{bmatrix} I & 0 \\ R & Q \end{bmatrix} \tag{20}$$

I: An r-by-r indentity matrix. It gives probabilities of being in an absorbing state.
0: An r-by-k zero matrix. It gives the possibility of transition from an absorbing state to a transient state.
R: A nonzero k-by-r matrix. It gives the possibilities of transition from any transient state to an absorbing state.
Q: An k-by-k matrix. It gives the possibilities of transition from any transient state to other transient states.
The answer to the question that how many times will the process be in each transient state until it was absorbed, is obtained from the relation

$$\mathbb{E} = (I - Q)^{-1} \tag{21}$$

This matrix is called the fundamental matrix (Çelik, 2013, p. 31).

k : The number of transient steps of the absorbing Markov chain.

$\mathbb{E}$: $(k \times k)$ fundamental matrix.

C: $(k \times 1)$ column vector all of whose entries are 1.

The required number of steps until the process is absorbed consists of the components of the $\mathbb{E}C$ vector.

B represents a matrix and the probability that the process will end up in a given absorbing state is found as follows:

$$B = (I - Q)^{-1}R \tag{22}$$

2.2.4. Periodic Markov Chains

The period of the $x \in E$ state,

$$d(x) = GCD\{n \geq 1 | P(X_n = x | X_0 = x) > 0\} \tag{23}$$

for $\forall n \geq 1$,

$$\text{if } P(X_n = x | X_0 = x) = 0, \text{ is defined as } d(x) = \infty. \tag{24}$$

If $d(x) = 1$, x is called aperiodic (Çelik, 2013, p. 48). In a periodic Markov chain, after leaving a state, the number of steps to return to that state is a multiple of integer $d > 1$ (Stewart, 1994; 10). According to this, the distribution vector never tends to an equilibrium value (Gebali, 2008, p. 185).

There are two types of periodic Markov chains, as strongly periodic and weakly periodic. In a strong periodic Markov chain, the probability of returning to the initial state after d steps is unity, namely $\boldsymbol{P}^d = \boldsymbol{I}$, for all states of the process, whereas in a weakly periodic Markov chain, the probability of returning to the initial state after d steps is less than unity, namely $\boldsymbol{P}^d \neq \boldsymbol{I}$, for some or all states of the process(Gebali, 2008, p. 185).

2.2.5. Ergodic Markov Chains

An ergodic Markov chain is one of the special forms of Markov chains (Bayrak, 2010, p. 20). If it is possible to move from each state to all other states, the Markov Chain is called an Ergodic chain (Grinstead and Snell, 2012, p. 433). It is not necessary to go from any situation to any other situation in one move. The important thing is that the system goes from one state to another, even if indirectly, that is, the states must be able to transition between each other (Öz, 2009, p. 29).

If there is an stationary probability distribution $\pi_1, \pi_2, \ldots, \pi_r$ in a Markov chain with r state, and

$$\lim_{n \to \infty} P_{ij}^{(n)} = \pi_r \tag{25}$$

for any i and j states, then the markov chain is the ergodic chain (Eroğlu, 1986, p. 27).
If all elements of some power of the transition matrix are positive, namely, if there is no zero, then a Markov Chain is called a regular chain, and the regularity of a chain indicates that the chain is ergodic (Akyurt, 2005, p. 35). However, a chain that is ergodic does not necessarily have to be regular (Gringstead and Snell, 2012, p. 433).

2.2.6. Equilibrium in Markov Chains

As the number of steps (n) increases in a Markov chain, the importance of the initial state decreases, and the transition probability matrix tends to be stationary (Bayrak, 2010, p. 22). After a certain period, an ergodic and irreducible Markov chain goes into equilibrium with probability π_j independently of its initial state i (Akyurt, 2011, p. 52).

$\pi = [\pi_0, \pi_1, \ldots, \pi_s]$ is the equilibrium distribution vector, and the equilibrium distribution of the system is found by calculating

$$\pi_j = \sum_{k=1}^{k=S} \pi_k p_{kj} \tag{26}$$

However, when the equation is solved, an infinite number of results can be obtained. To achieve odd and positive values of the equilibrium state, $\pi_1, \pi_2, \ldots, \pi_s$ must be equal to 1 (Akyurt, 2011, p. 53).

$$\sum_{j=0}^{\infty} \pi_j = 1 \tag{27}$$

3. HIDDEN MARKOV MODEL (HMM)

A Hidden Markov Model (HMM) is a powerful statistical analysis instrument that is used for modeling time series data (Oflaz, 2016, p. 11). The first main theory of HMM was published in the late 1960s and early 1970s by Baum and Petrie (1966), Baum and Egon (1967), Petrie (1969), and Baum (1972). HMM, which has a wide application area, is used in areas such as economics (Wang and Alba, 2006; Hassan and Nath, 2005), speech recognition (Rabiner, 1989; Lee et al., 1990; Chien and Wang, 1997), biochemistry (Fredkin and Rice, 1992), neurology (Otterpohl et al., 2000; Shankle et al., 2016) and character recognition (Starner and Pentland, 1997; Feng and Ding, 2000).

A HMM is a statistical machine learning method for information retrieval (Seymore, McCallum and Rosenfeld, 1999, p. 37). The model is an expanded Markov Chains technique that includes the situation where observation is a probabilistic function of the state (Rabiner, 1989, p. 259). In the HMM, the state of the system cannot be observed at any time. Instead, it reveals the observation that caused this situation when the system was in a state (Haberdar, 2005, p. 16). The reason why these models are described as "hidden" is that the states of the system are unknown.

In the Markov model, when the system is in the state S_i, it can only be observed that the system is in the state i. Unlike this, in the HMM, one of the M different observations $\{ v_1, v_2, \dots, v_M\}$ is obtained depending on the probability function. $b_j(k)$ shows this probability. In a Markov model, the observation sequence is the state in which the system exists for each time t, whereas in a HMM, according to the values in the probability matrix, the observations produced by the system for each time t constitute observation sequence $O = O_1 O_2 \dots O_T$. In such a case, the state sequence Q is not clear (Haberdar, 2005, p. 17). Therefore, Q is called hidden.

A Hidden Markov Model is defined as follows:

- N represents the number of states in the model. Usually, the states are linked. Therefore, the transitions occur from one state to another. $S = \{S_1, S_2, \dots, S_N\}$ is set of states and q_t stands for state at time t.

- M represents the number of observations. $V = \{v_1, v_2, \dots, v_M\}$ is set of different possible observations.
- T is length of the observation sequence.
- $A = \{a_{ij}\}$ is state transition probability distribution. A is a matrix of size $N \times N$. The total of each row of the matrix is equal to 1. Each a_{ij} is a positive number for $1 \leq i, j \leq N$.
- $B = \{\, b_j(k)\}$ stands for observation transition probability distribution. Each $b_j(k)$ is a positive number for $1 \leq j \leq N$ and $1 \leq k \leq M$. B is a matrix of size $N \times M$ and total of each row of the matrix is equal to 1.
- $\pi = \{\pi_i\}$ represents initial state distribution. $\pi_i = P[q_1 = S_i]$, $1 \leq i \leq N$ is the probability of the first step.
- Using appropriate values of N, M, A, B and π, an observation sequence, $O = O_1, O_2, \dots, O_T$, is produced (Rabiner , 1989, p. 261).
- $\lambda = (A, B, \pi)$ is the compact notation of the complete parameter set of the model.

3.1. The Three Basic Problems of HMM

There are three basic problems of the HMM that must be solved for real-world applications (Rabiner, 1989, p. 261). These problems are about how the probability of the observations is calculated accurately, how a hidden state sequence is estimated and how the model parameters are adjusted. These problems are the following:

Problem 1: Given a model parameter $\lambda = (A, B, \pi)$ and the observation sequence $O = O_1, O_2, \dots, O_T$, how can the probability $P(O|\lambda)$ of the observation sequence be calculated effectively?

Problem 1 is also called the evaluation problem. In other words, it is about how the probability that the observed sequence generated by the model is computed. Besides, this problem can be examined as the problem of how well a given model suits a given observation sequence.

For the solution of problem 1, namely P (O | λ) to be calculated, forward and backward algorithms are used. The values obtained as a result of both algorithms are found the same.

Problem 2: How is a state sequence $Q = q_1, q_2, \dots q_T$, which best describes the observations, chosen for a given observation sequence $O = O_1, O_2, \dots., O_T$, and the model λ?
The problem is about disclosure of the hidden part of the HMM, namely discovering the true state sequence. The state sequences are determined according to the number of states, and the most suitable one is selected among these state sequences. Viterbi algorithm is used to solve problem 2.

Problem 3: How is the model parameters $\lambda = (A, B, \pi)$ adjusted for maximizing $P(O|\lambda)$? The problem is about trying to enhance model parameters to best define how an observation sequence arises. The observation sequence, which is employed to adjust the model parameters, is used to train the HMM. Therefore, problem 3 is generally listed as the Training Problem in the literature.
Baum-Welch Algorithm is used for the estimation of the parameters $\lambda = (A, B, \pi)$ of the HMM in the training phase.

3.2. Solitons to the Three Basıc Problems of HMM

3.2.1. Solution of Problem 1

The probability of the observation sequence $P(O|\lambda)$, given the model $\lambda = (A, B, \pi)$ and observation sequence $O = O_1, O_2, \dots., O_T$, must be calculated to solve the problem. Therefore, each possible state sequence of length T is enumerated for this calculation. A fixed steady-state sequence, where q is the initial state, is represented in the following.

$$Q = q_1 q_2 \dots q_T \tag{28}$$

The probability of observation sequence, O, for the equation (28) is

$$P(O|Q, \lambda) = \prod_{t=1}^{T} P(O_t | q_t, \lambda) \tag{29a}$$

Assuming that the observations are statistically independent of each other, the following equations can be written:

$$P(O|Q, \lambda) = b_{q_1}(O_1).b_{q_2}(O_2) \dots b_{q_T}(O_T) \tag{29b}$$

The probability of such a state sequence Q is represented as

$$P(O|\lambda) = \pi_1 a_{q_1 q_2} a_{q_2 q_3} \dots a_{q_{T-1} q_T} \tag{30}$$

The joint probability of O and Q, namely the probability that O and q occur simultaneously can be written as

$$P(O, Q|\lambda) = P(O|Q, \lambda). P(Q|\lambda) \tag{31}$$

The probability of O is derived from summing this joint probability entire possible state sequences q giving

$$P(O|\lambda) = \sum_{all\ Q} P(O|Q, \lambda). P(Q|\lambda) \tag{32}$$

$$P(O|\lambda) = \sum_{q_1, q_2, \dots, q_T} \pi_{q_1} b_{q_1}(O_1) a_{q_1 q_2} b_{q_2}(O_2) a_{q_2 q_3} \dots b_{q_T}(O_T) a_{q_{T-1} q_T} \tag{33}$$

The explanation for the above equation is the following. When the system is at the initial moment ($t = 1$), it is in state q_1 with probability π_{q_1} and produces the observation O_1 with probability $b_{q_1}(O_1)$ in this state. When the time passes from t to t +1 (t = 2), the system switches from state q_1 to state q_2 with the probability $a_{q_1 q_2}$, and the observation O_2 is generated with the probability $b_{q_2}(O_2)$ in state q_2. The process continues until the system switches from state q_{T-1} to state q_T with probability $a_{q_{T-1} q_T}$ at time T and it produced the observation O_T with the probability $b_{q_T}(O_T)$.

Since there are N states in an observation sequence, there are N^T possible state sequences. In order to calculate $P(O|\lambda)$ according to its direct definition, $(2T - 1)N^T$multiplications and $N^T - 1$ additions are required.

The large number of multiplication and addition operations makes the calculation of the equation (6) challenging. For this reason, Forward and Backward Algorithms are used in the calculation of $P(O|\lambda)$.

3.2.1.1. Forward Algorithm

The forward variable, $a_t(i)$, defined as

$$a_t(i) = P(O_1 O_2 \dots O_t, q_t = S_i|\lambda) \tag{34}$$

Given the model, forward variable $a_t(i)$ is the probability of the partial observation sequence $O_1 O_2 \dots O_t$ at time t and in state S_i. Forward variable $a_t(i)$ can be solved inductively, as follows:

Initialization;

$$a_t(i) = P(O_1, q_1 = S_i|\lambda) \tag{35a}$$

$$a_t(i) = P(O_1|q_1 = S_i, \lambda)P(q_1 = S_i|\lambda) \tag{35b}$$

$$a_t(i) = \pi_i b_i(O_1), \qquad t = 1, 1 \leq i \leq N \tag{35c}$$

Induction;

$$a_{t+1}(j) = \left[\sum_{i=1}^{N} a_t\,(i) a_{ij}\right] b_j(O_{t+1}), \;\; 1 \leq t \leq T-1, \;\;\; 1 \leq j \leq N \tag{36}$$

Termination;

$$(O|\lambda) = \sum_{i=1}^{N} a_T\,(i) \tag{37}$$

3.2.1.2. Backward Algorithm

The backward variable,$\beta_t(i)$, described as:

$$\beta_t(i) = P(O_{t+1} O_{t+2} \dots O_T|q_t = S_i, \lambda) \tag{38}$$

Given the model λ and state S_i at time t, $\beta_t(i)$ is the probability of the observation sequence from time $t+1$ to the last moment of the system. $\beta_t(i)$ can be solved inductively, as follows:
Initialization;

$$\beta_T(i) = 1, \quad 1 \leq i \leq N \tag{38}$$

Induction;

$$\beta_T(i) = \sum_{j=1}^{N} a_{ij}\, b_j(O_{t+1})\beta_{t+1}(j), \quad t = T-1, T-2, \dots, 1, \quad 1 \leq i \leq N \tag{39}$$

3.2.2. Solution of Problem 2

Viterbi Algorithm is used to choose a state sequence $Q = q_1, q_2, \dots q_T$, which best describes the observations.

3.2.2.1. Viterbi Algorithm

The variable $\delta_t(i)$ is defined to express to process in state S_i and at time t, which expresses the highest probability up to time t, for the solution of Problem 2.

$$\delta_t(i) = \max_{q_1, q_2, \dots, q_{t-1}} P[q_1, q_2, \dots, q_t = i, O_1, O_2, \dots, O_t | \lambda] \tag{40}$$

Equation (41) is obtained by induction from equation (40).

$$\delta_{t+1}(j) = [\max_i \delta_t(i) a_{ij}]. b_j(O_{t+1}) \tag{41}$$

Independent variable, which maximizes y for every t and j, must be pursued to literally reclaim the state sequence. This is done via the array $\psi_t(j)$.

The steps of the Viterbi algorithm are given below:

Initialization;

$$\delta_1(i) = \pi_i b_i(O_1), \quad 1 \leq i \leq N \tag{42}$$

$$\psi_1(i) = 0 \tag{43}$$

Recursion;

$$\delta_t(j) = \max_{1 \le i \le N} [\delta_{t-1}(i) a_{ij}] b_j(O_t), \qquad 2 \le t \le T, \qquad 1 \le j \le N \tag{44}$$

$$\psi_t(j) = \arg\max_{1 \le i \le N} [\delta_{t-1}(i) a_{ij}], \quad 2 \le t \le T, \quad 1 \le j \le N \tag{45}$$

Termination;

$$P^* = \max_{1 \le i \le N} [\delta_T(i)] \tag{46}$$

$$q_T^* = \arg\max_{1 \le i \le N} [\delta_T(i)] \tag{47}$$

Path (state sequence) backtracking;

$$q_t^* = \psi_{t+1}(q_{t+1}^*), \qquad t = T-1, T-2, \dots, 1 \tag{48}$$

3.2.3. Solution of Problem 3

Baum-Welch Algorithm is used to estimate the parameters $(A, B, \pi)$of the Hidden Markov Model.

3.2.3.1. Baum-Welch Algorithm

To define the procedure for re-estimating HMM parameters, given the model and the observation sequence, first $\xi_t(i,j)$, probability of being in state S_i at time t and in state S_j at time $t+1$, is described.

$$\xi_t(i,j) = P(q_t = S_i, q_{t+1} = S_j | O, \lambda) \tag{49}$$

Using the definitions of the forward and backward variables, $\xi_t(i,j)$ can be written as follows:

$$\xi_t(i,j) = \frac{a_t(i)a_{ij}b_j(O_{t+1})\beta_{t+1}(j)}{P(O|\lambda)} \tag{50}$$

Given the model and the observation sequence, the connection between $\gamma_t(i)$, the probability of being in the state S_i at time t, and $\xi_t(i,j)$ is written as follows:

$$\gamma_t(i) = \sum_{j=1}^{N} \xi_t\,(i,j) \tag{51}$$

The equations given above are used to re-estimate Hidden Markov Model parameters. New parameters are denoted by (A, B, π) and equations for estimation of these parameters are given below:

$$\overline{\pi_\imath} = \gamma_1(i), \overline{a_{\imath\jmath}} = \frac{\sum_{t=1}^{T-1}\gamma_t(i,j)}{\sum_{t=1}^{T-1}\gamma_t(i)}, \overline{b_\jmath}(k) = \frac{\sum^{T}{}_{\substack{t=1\\O_t=v_k}}\ \gamma_t(j)}{\sum_{t=1}^{T}\gamma_t(j)} \tag{52}$$

3.3. Emission Matrix

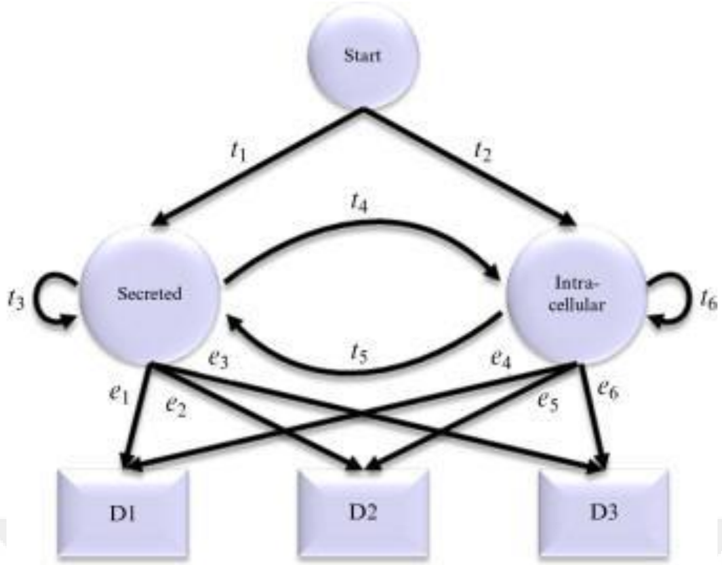

Figure 3. 1. Hidden Markov Display
Source: Kıral, 2020, p. 36

The figure above is a simple representation of a Hidden Markov Model. In this figure, the t's show the possibilities of transition from one state to another in a HMM. D's represent the observations that can occur after the system reaches a state, while e's represent the probabilities of these observations, namely, the emission probabilities. Since the transitions from states to other states and from those states to observations in a Hidden Markov Model are driven by the transition and emission probabilities, the hidden states in the model are determined by multiplying the emission and transition probabilities.

4. AN APPLICATION ON HOTEL BUSINESSES

4.1. Hotels Included in the Study and Their Features

In the application phase of this study, 4 and 5 star hotels with beaches in the province of Mersin were included. Mersin, which is the 11th largest city of Turkey, was chosen for the study. Mersin is one of the most important cities of Turkey in terms of history, culture and natural beauties, spread an over wide geography in the Mediterranean region. Mersin has 321 km of coastline and 108 km of it consists of natural beaches (Mersin Governorship, 2021). Mersin is a city, preferred by tourists due to its proximity to Eastern Anatolia, Southeastern Anatolia and Central Anatolia and being more economical than the other Mediterranean and Aegean cities.

Mersin, which is located in the region called Cilicia in history, has been one of the most significant cities of this region throughout history. Mersin with its history dating back to the Proto-Chalcolithic and Neolithic ages has hosted many different civilizations such as Hittites, Babylonians, Persians, Greeks, Armenians, and Seleucids (T.R. The Ministry of Culture and Tourism, 2021). There are many historical places to visit in Mersin, such as Cleopatra Gate, Adamkayalar, Chasm of Heaven and Hell, Maidens Tower Sea Castle, Anamurium Ancient City, Mamure Castle, Nagidos Ancient City, Yumuktepe and Elaiussa Sebaste Ancient City. Moreover, Mersin is an ideal city for sea tourism with its beaches, such as Taşucu, Narlıkuyu, Susanoğlu, Ören, Akkum, Kapızlı, and Kızkalesi. In addition, being located on the route of the Christian pilgrimage enabled Mersin to have great importance not only in terms of geography and history but also in terms of religion.

Table 4. 1. Accommodation Facilities with Investment and Operation Certificates in Mersin

	Number of Facilities	Number of Rooms	Number of Beds
Operation Certificate	45	2.853	5.960
Investment Certificate	34	3.334	7.282
TOTAL	79	6.187	13.242

Source: Mersin Governorship (2021)

Although there are a total of 79 accommodation facilities in Mersin, 4 and 5-star hotels with beaches were included in the study in order to give more accurate and precise results. Therefore, 10 hotels were determined for the study.

Table 4. 2. Hotels Included in the Study and Their Features

Hotels	**Rank**	**Room**	**Bed**	**Blue Flag**	**Safe Tourism Certificate**	**Spa/wellness**
Wonasis Resort& Aqua Hotel[*]	*****	320			×	×
Ulu Resort Hotel	*****	285	900	×	×	×
Liparis Resort Hotel& Spa	*****	148	260	×	×	×
Lamos Resort Hotel	*****	170	372		×	×
Sahil Martı Hotel	****	66	132		×	×
Hotel Royal Sebaste	****	108	275			×
Altın Orfoz Hotel	****	112	232	×	×	×
Marvel Tree	****	31	96			
Olbios Marina Resort Hotel	****	96	272	×	×	×
Marpessa Blue Beach Resort& Spa Hotel	****	74	180		×	×

For Blue Flag Source: Türçev (2021)
For Safe Tourism Certificate: Türkiye Tourism Promotion and Development Agency (2021)
[*] Its name was changed to Doramar Resort & Aqua.

Looking at the table, it can be seen that the names, ranks, number of rooms and beds, whether the hotels have a safe tourism certificate and spa/ wellness and whether their beaches are blue flagged or not of the hotels included in the study.

Blue Flag is an international environmental award given to qualified beaches and marinas that meet the required criteria. Beaches that meet 33 criteria in total are awarded the Blue Flag for a period of 1 year. These criteria are divided into 4 main groups (T.R. The Ministry of Culture and Tourism, 2021)

- Water Quality
- Environmental Education And Information
- Environmental Management
- Safety and Services.

According to the table 4.2, Ulu Resort Hotel, Liparis Resort Hotel & Spa, Altın Orfoz Hotel and Olbios Marina Resort Hotel met 33 criteria and were awarded the Blue Flag.

T.R. Safe Tourism Certification Program initiated by the Ministry of Culture and Tourism; covers the health and hygiene rules that the facilities must comply with. Except for Hotel Royal Sebaste and Marvel Tree, all of the hotels included in the study have a safe tourism certificate. Especially in this pandemic environment, the fact that hotels have such a certificate will allow people to have a healthy holiday without fear. In this increasingly competitive environment, hotels that do not have this certificate can never compete with other hotels.

Other features of the hotels in the study are briefly mentioned below.

Wonasis Resort & Aqua Hotel was established on a total of 60 decares of land in the town of Kargıpınarı. It has a 2 km private sand beach. There are 3 pools in the hotel, the main pool, the indoor pool, and the aqua pool. In addition, the hotel has 3 restaurants: main, snack, and a la carte.

Ulu Resort Hotel was established on an area of 27.000 square meters in Yanışlı, Ortaburun Tourism Region. It has 850 m^2 of beach. The hotel has an Aquapark. There are areas where activities such as water gymnastics, step & aerobics, darts, archery, etc. can be done.

Liparis Resort Hotel & Spa was established in Ayas Town. It has 400 meters of beach. The hotel has a disco, playground, aquapark, indoor and outdoor pools.

Lamos Resort Hotel was established in Erdemli. The hotel has a fitness center, game room, playground, indoor and outdoor swimming pools. There is also live music every evening.

Sahil Martı Hotel is located 10 km west of Mersin, offers bed and breakfast and half-board accommodation to its guests. The hotel provides service for 12 months. The hotel has a total of 1 restaurant and 1 Antik bar.

Hotel Royal Sebaste was established in Ayaş town of Erdemli. The hotel has a fitness center, sauna, steam room, massage rooms and Turkish bath. In addition, the hotel has Lobby Bar, Snack Bar and Pool Bar.

Altın Orfoz Hotel is located 17 km from Silifke city center and 130 km from Adana Airport. It has a 40 km long beach. The hotel has a children's playground, spa center, indoor and outdoor restaurant.

Marvel Tree was established on an area of 5,000 square meters in Bozyazı. It has a 500 meter long beach and the facility has its own pier. The hotel serves as an open buffet in half board concept. There are areas such as a disco, children's playground and a library in the hotel.

The Olbios Marina Resort Hotel was established in Erdemli, next to the ruins of Akkale, on an area of 50.000 m^2. It has 100 meters of sandy beach. In addition, the hotel received an award from the “Green Key” program, an international eco-label that supports initiatives to protect the environment by awarding them, and aims to prevent climate change and contribute to sustainable tourism. With the “Green Star” award given by the Ministry of Tourism and received as a result of the inspection by the Ministry, an environmental awareness plaque was given to a business for the first time in the Çukurova region.

The Marpessa Blue Beach Resort & Spa Hotel was established in the Yeşilovacık neighborhood of Silifke district. It has a 350 m^2 beach. The hotel has a fitness center, steam room and a Turkish bath.

In this study, the Markov Chains method and Hidden Markov Model were used to determine the next hotel preferences and to analyze the factors affecting these preferences of 4 and 5-star hotels with beaches in Mersin province. The reason for using the Markov chain method in the study is that the method has many advantages in terms of future predictions. Markov Chains is a method based on the assumption that the probability of any future event occurrence is calculated by using only current data regardless of past data (Eroğlu, 1986, p. 5). From this point of view, it is expected to give reliable results for the next period hotel preferences of hotel customers. In order to use the Markov Chain method, it is necessary to know the various situations that the system can be in and the possibilities of transition from one state to another.

In the Markov Chain method, the transition from one state to another is not dependent on past situations, but only on the previous situation. Because of this feature, it is sufficient to know the situation of the system in order to apply the Markov Chain method. From this point of view, it emerges that Markov has a wide application area. It is seen that it is widely and successfully used in Sciences and especially in Social Sciences (Kıran, 2009, p. 3). Today, it is known that businesses frequently use this method when creating their marketing strategies. Thanks to this method, businesses can easily predict the future attitudes and behaviors of consumers.

The required sample size was calculated using the equation below.

$n = \frac{z^2pq}{e^2}$ (Cochran(1963) cited by Israel, 1992, p. 3)

n: Sample Size

z: Standart Error

p: Variability/ Standard Deviation

q:$1 - p$

e: Acceptable Sample Error

While calculating the sample size required for the study, the variability (p) was taken as 0.5. Standard Error (z) was taken as 1.96, and acceptable sample error (e) was taken as 0.05. When these values are placed in the equation the resulting size is as below:

$$\frac{(1.96)^2(0.5)(0.5)}{(0.05)^2} \approx 384$$

As it can be seen, for a 95% confidence level and ±5% precision the sample size is 384. According to this result, it is sufficient to survey 384 people about their hotel preferences and the factors affecting these preferences for this study, but in order for the study to give more accurate results, a questionnaire was applied to more people than this number.

410 people were asked about their next hotel preferences and the reasons that affect these preferences. If these people had not previously stayed at any of the hotels in the survey, this is stated as none.

The sequence numbers of the hotels in the survey are shown in Table 4.3.

Table 4. 3. 4 and 5 Star Hotels with Beaches

Sequence Number	Hotel	Sequence Number	Hotel
1	None	**7**	Hotel Royal Sebaste (4*)
2	Wonasis Resort& Aqua Hotel (5*)	**8**	Altın Orfoz Hotel (4*)
3	Ulu Resort Hotel (5*)	**9**	Marvel Tree (4*)
4	Liparis Resort Hotel& Spa (5*)	**10**	Olbios Marina Resort Hotel (4*)
5	Lamos Resort Hotel (5*)	**11**	Marpessa Blue Beach Resort& Spa Hotel (4*)
6	Sahil Martı Hotel (4*)		

4.2. Determining Next Hotel Preferences Using Markov Chains Method

The states in the Markov analysis method are shown in Table 4.3. In order to predict the next term and long term hotel preferences, participants' preferences for the previous hotel and the hotel they plan to stay in were determined. Transition probability matrix was created according to the number of transitions between states. Then the initial probabilities were determined and the Equilibrium (Fixed) probabilities were calculated.

The Markov transition matrix was created with the help of the data obtained from the survey and is shown in Table 4.4. The numbers showing the columns in this matrix are the hotels in Table 4.3 and show the hotels where the next accommodation is planned. The numbers showing the rows are the hotels in Table 4.3 and show the previous accommodated hotels. The point where any column and row intersect gives the number of transition from the previous hotel to the next one. If we look at Table 4.4, there are 5 people whose previous hotel preference was the Altın Orfoz Hotel (4 *) and the next hotel preference would be Ulu Resort Hotel (5 *). The Markov Transition Probability Matrix was created by taking into account the number of transitions from any hotel to other hotels given in the Markov transition matrix.

Table 4. 4. Transition Matrix

		The Hotels Where The Next Accommodation Is Planned										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
The Previous Accommodated Hotels	**1**	120	26	22	12	3	5	1	24	11	2	4
	2	5	7	4	3	1	0	0	1	0	2	2
	3	8	0	12	2	2	0	0	2	2	1	1
	4	4	2	0	8	0	0	1	0	0	0	0
	5	1	3	1	1	1	1	0	1	1	0	0
	6	3	3	1	1	1	4	0	3	0	0	2
	7	1	0	1	3	0	0	1	0	0	0	0
	8	7	3	5	5	7	0	0	13	0	2	2
	9	3	0	3	0	0	0	0	0	5	0	0
	10	0	0	3	1	0	0	0	2	0	0	1
	11	0	0	4	0	0	0	0	1	1	0	8

Markov transition probability matrix obtained by using the transition matrix in Table 4.4 is given in Table 4.5. The Markov transition probability matrix is formed by dividing the number in each cell of the transition matrix by the total value of the row in which it is located.

Markov Transition Probability Matrix given in Table 4.5 shows the next preference rates for each hotel. In addition, the loyalty of the hotel customers to the hotel, namely, the fact that the previous hotel is the same as the hotel where the next accommodation is planned, is shown in the diagonal elements of the Markov Transition Probability Matrix.

Table 4. 5. Transition Probability Matrix

		The Hotels Where The Next Accommodation Is Planned										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
The Previous Accommodated Hotels	**1**	0,5217	0,1130	0,0957	0,0522	0,0130	0,0217	0,0043	0,1043	0,0478	0,0087	0,0174
	2	0,2000	0,2800	0,1600	0,1200	0,0400	0,0000	0,0000	0,0400	0,0000	0,0800	0,0800
	3	0,2667	0,0000	0,4000	0,0667	0,0667	0,0000	0,0000	0,0667	0,0667	0,0333	0,0333
	4	0,2667	0,1333	0,0000	0,5333	0,0000	0,0000	0,0667	0,0000	0,0000	0,0000	0,0000
	5	0,1000	0,3000	0,1000	0,1000	0,1000	0,1000	0,0000	0,1000	0,1000	0,0000	0,0000
	6	0,1667	0,1667	0,0556	0,0556	0,0556	0,2222	0,0000	0,1667	0,0000	0,0000	0,1111
	7	0,1667	0,0000	0,1667	0,5000	0,0000	0,0000	0,1667	0,0000	0,0000	0,0000	0,0000
	8	0,1591	0,0682	0,1136	0,1136	0,1591	0,0000	0,0000	0,2955	0,0000	0,0455	0,0455
	9	0,2727	0,0000	0,2727	0,000	0,0000	0,0000	0,0000	0,0000	0,4545	0,0000	0,0000
	10	0,0000	0,0000	0,4286	0,1429	0,0000	0,0000	0,0000	0,2857	0,0000	0,0000	0,1429
	11	0,0000	0,0000	0,2857	0,0000	0,0000	0,0000	0,0000	0,0714	0,0714	0,0000	0,5714

When Table 4.5 is examined, the probabilities of transition from each state to another state will be seen. For example; when the second row of Table 4.5 is examined, the probability of people who have previously stayed at Wonasis Resort & Aqua Hotel (2) would not choose any hotel (1) in their next hotel choice is 20%, and the probability of choosing Wonasis Resort & Aqua Hotel (2) again is 28%, the probability of choosing Ulu Resort Hotel (3) is 16%, the probability of choosing Liparis Resort Hotel& Spa (4) is 12%, the probability of choosing Lamos Resort Hotel (5) is 4%, the probabilities of choosing Sahil Martı Hotel (6) and Hotel Royal Sebaste (7) are 0%, the probability of choosing Altın Orfoz Hotel (8) is 4%, the probability of choosing Marvel Tree (9) is 0% and finally the probabilities of choosing Olbios Marina Resort Hotel (10) and Marpessa Blue Beach Resort& Spa Hotel (11) are 8%. Looking at the given example, it has been determined that people whose previous hotel preference was Wonasis Resort & Aqua Hotel (2) were more likely to choose Wonasis Resort

& Aqua Hotel (2) than other hotels. This result can be interpreted that most of the participants whose previous hotel preference was Wonasis Resort & Aqua Hotel (2) are satisfied with Wonasis Resort & Aqua Hotel.

The probabilities of hotel customers to choose the same hotel in their next hotel preferences, namely their loyalty to the hotel, are respectively Marpessa Blue Beach Resort & Spa Hotel (4*) with 57,14%, Liparis Resort Hotel & Spa (5*) with 53,33%, Marvel Tree (4*) with 45,45%, Ulu Resort Hotel (5*) with 40%, Altın Orfoz Hotel (4*) with 29,55%, Wonasis Resort & Aqua Hotel (5*) with 28%, Sahil Martı Hotel (4*) with 22,22%, Hotel Royal Sebaste (4*) with 16,67%, Lamos Resort Hotel (5*) with 10% and Olbios Marina Resort Hotel (4*) with 0%. According to these results, participants' loyalty to Marpessa Blue Beach Resort & Spa Hotel (11) is higher than their loyalty to other hotels. This situation can be interpreted as most of the participants whose previous hotel preference was Marpessa Blue Beach Resort & Spa Hotel (11) are satisfied with this hotel and they want to stay at Marpessa Blue Beach Resort & the Spa Hotel (11) again.

In addition, in Table 4.5, we can see the first hotel choice of participants who have not stayed in any of the hotels included in the study. Accordingly, 11,30% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Wonasis Resort & Aqua Hotel (2). 9,57% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Ulu Resort Hotel (3). 5,22% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Liparis Resort Hotel& Spa (4). 1,30% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Lamos Resort Hotel (5). 2,17% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Sahil Martı Hotel (6). 0,43% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Hotel Royal Sebaste (7). 10,43% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Altın Orfoz Hotel (8). 4,78% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Marvel Tree (9). 0,87% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Olbios Marina Resort Hotel (10). Finally, 1,74% of the participants who gave the answer of none (1) to the hotel previously stayed in the survey will prefer Marpessa Blue Beach

Resort& Spa Hotel (11). According to these percentages, most of the participants who have not stayed in any of the Mersin hotels included in the study would prefer Wonasis Resort & Aqua Hotel (2) as their first hotel choice. The reason for this result shows that people who have stayed at Wonasis Resort & Aqua Hotel (2) before are satisfied with their accommodation experience and recommend it to others.

In order to determine the preference rates of the hotels in the long term, an initial probability vector must be created. The initial probability vector (Table 4.6) was obtained by dividing the total number of rows in the Transition Matrix to the number of people participating in the survey.

Table 4. 6. The Initial Probability Vector

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
0,5610	0,0610	0,0732	0,0366	0,0244	0,0439	0,0146	0,1073	0,0268	0,0171	0,0341

Since 230 of the 410 people participating in the survey (the sum of the first line in Table 4.4) have not stayed in any (1) of the hotels included in the study, the first element of the initial probability vector was obtained as 230/410 = 0.5610. Similarly, calculations were made for other states and the elements of the initial probability vector were obtained.

In the Markov chain method, as the periods pass, the values in the initial probability vector reach a stationary value and these stationary values are called equilibrium (fixed) probabilities. By multiplying the initial probability vector given in Table 4.6 with the Markov transition probability matrix (Table 4.5), the initial probability vector is obtained for the next period and the multiplication process is continued until the stationarity is reached. In this direction, the initial probability vector for the next summer term was calculated and shown in Table 4.7.

Table 4. 7. The Initial Probability Vector for the Next Period

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
0,3707	0,1000	0,1366	0,0878	0,0366	0,0244	0,0073	0,1146	0,0488	0,0171	0,0488

In the Markov Chains analysis, it is observed that the values reach a stable state as the periods pass. These stationary values are obtained by multiplying the Initial probability vector in

Table 4.6 with the Markov transition probability matrix repeatedly until the stationarity is reached. In this study, it has been observed that at the end of 29 periods, stability is achieved, namely, the initial probability vector is fixed.

Table 4. 8. Equilibrium (Fixed) Vector

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
0,2919	0,0974	0,1724	0,1325	0,0377	0,0130	0,0121	0,0880	0,0618	0,0201	0,0628

When the Initial Probability Vector (Table 4.6) and the Equilibrium (Fixed) Vector (Table 4.8) are compared, it is seen that not choosing any hotel decreased from 56.10% to 29.19%. Considering the status of the hotels, it has been determined that the three most preferred hotels are Ulu Resort Hotel (3), Liparis Resort Hotel & Spa (4) and Wonasis Resort & Aqua Hotel (2), respectively. It is observed that the preference probability of Sahil Martı Hotel (6) decreased from 4,39% to 1,30%, the preference probability of Hotel Royal Sebaste (7) decreased from 1,46% to 1,21% and the preference probability of Altın Orfoz Hotel (8) decreased from 10,73% to 8,80%. It was determined that other hotels increased the preference probabilities. When compared with other hotels, it has been determined that Ulu Resort Hotel (3) will be the most preferred hotel in the long term by increasing the choice possibilities more. On the other hand, Altın Orfoz Hotel (8) was the most preferred hotel according to the initial probability vector and fell to fourth place among the hotels by decreasing its long-term preference rates.

4.3. Determining The Factors Affecting Hotel Preferences Using Hidden Markov Model

In this study, the HMM was used to determine the factors affecting the preference of 4 and 5-star hotels with beaches in Mersin, that is, the hidden reason behind their choice. The questionnaire consisting of 11 questions was applied to 410 people using simple random sampling. The data obtained from the survey were first transferred to Excel, and transition and emission matrices were created. The created matrices were analyzed with the help of the MATLAB program and the hidden reasons underlying the choice of 4 and 5-star hotels with beaches in Mersin were determined.

Information about the people participating in the study is given below.

Table 4. 9. Gender

Gender	Number of Participants	Percantage
Female	263	64,1
Male	147	35,9
Total	410	100,0

When the information given in Table 4.9 is examined, it will be seen that the total number of people participating in the survey is 410, 263 of these 410 people, namely 64,1%, is female, and the remaining 147 people, namely 35,9%, are men.

Table 4. 10. Age

Age	Number of Participants	Percentage
18-25	95	23,17
26-35	109	26,58
36-45	79	19,27
46-55	89	21,71
56-67	38	9,27

When the information given in the table 4.10 is examined, it is seen that the participants are between the ages of 18-67.

Table 4. 11. Education Level

Education Level	Number of Participants	Percentage
Primary	0	0,0
Middle school	7	1,7
High school	28	6,8
Associate Degree	22	5,4
Bachelor's Degree	302	73,7
Graduate Degree	51	12,4

When Table 4.11 is examined, it is seen that 1,7% of the participants are middle school graduates, 6,8% of the participants are high school graduates. 5,4% of participants have an associate degree and 12,7% participants have a graduate degree. It is clearly seen that the majority of the people participating in the survey, that is 73,7%, have a bachelor’s degree.

Table 4. 12. Occupation

Occupation	Number of Participants	Percentage
Not employed	80	19,5
Student	63	15,4
Civil Servant	165	40,2
Private sector	102	24,9

When looking at Table 4.12, it was determined that 80 of 410 people participating in the study were not working, 63 were students, 165 were civil servants and 102 were private sector employees.

Table 4. 13. Monthly Income

Monthly Income	Number of Participants	Percentage
0 TL- 2500 TL	95	23,2
2500-5000 TL	121	29,5
5000-7500 TL	113	27,6
7500 TL or more	81	19,8

According to Table 4.13, 23,2% of the participants in the study have an income of 2500 TL or less. 29,5% of the participants have an income between 2500 TL and 5000 TL, 27, 6% of the participants have an income between 5000 TL and 7500 TL, and finally, 19, 8% of the participants have an income of 7500 TL or more.

Table 4. 14. Marital Status

Marital Status	Number of Participants	Percentage
Married	239	58,3
Single	151	36,8
Divorced	15	3,7
Widowed	5	1,2

When Table 4.14 is examined, it is seen that 239 of 410 people participating in the survey are married, 151 are single, 15 are divorced, and 5 are widows.

Table 4. 15. Number of Children

Number of Children	Number of Participants	Percentage
0	180	43,9
1	66	16,1
2	133	32,4
3 or more	31	7,6

According to Table 4.15, 43,9% of the participants do not have a child. On the other hand, the remaining 56,1% have children. Among those with children, those who have two children constituted the majority with 32,4%.

Transition probability matrix and emission matrices were created based on the information obtained from the answers given by 410 participants to the questions below.

- Which of the following Mersin hotels have you stayed in, or are you currently staying in?
- What was the most significant factor in choosing the hotel you stayed in for the last time?
- Which hotel would you consider staying in on your next holiday in Mersin?
- What is the most significant factor that will make you choose the hotel you are planning to stay in next?

The transition probability matrix was created by using the previous and next preference reasons for the factors affecting hotel preferences. The reasons for choosing 4 and 5-star hotels with beaches in Mersin are shown in Table 4.16.

Table 4. 16. The Reasons for Choosing 4 and 5-Star Hotels with Beaches in Mersin

Symbol	Reasons
D1	Location
D2	Room and Facility Cleaning
D3	The Friendly and Qualified Staff at A Hotel
D4	Room prices / Special Offers
D5	Beach and Pool
D6	Availability of Facilities for Families with Children
D7	All-inclusive- Full board
D8	Various Activities and Entertainment at a Hotel
D9	Effectiveness of Recommendations/Advertisement
D10	Other

The Di's show the states of the HMM. The transition matrix (Table 4.17) was created with the information obtained from the survey.

Table 4. 17. Transition Matrix

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
D1	31	25	1	6	7	5	2	3	15	3
D2	6	38	3	1	3	0	3	2	4	1
D3	1	0	4	2	0	0	0	0	0	0
D4	3	6	3	19	2	0	3	4	3	1
D5	1	3	0	2	14	1	1	1	2	0
D6	0	1	0	1	0	22	1	1	1	1
D7	6	8	0	1	0	2	13	6	5	0
D8	3	7	2	0	0	0	1	4	1	0
D9	4	11	2	1	4	0	2	6	12	0
D10	8	5	1	5	3	0	4	2	4	14

In Table 4.17, the point where any column and row intersect gives the number of transitions of the reason for choosing the next hotel from the reason of choosing the previous hotel.

For example; while a person chose the hotel she stayed in last or is currently staying in because of the hotels' location, ıf that person is planning to stay at the next hotel because of the availability of facilities for families with children, a transition from D1 to D6 occurs. Furthermore, there are 15 people who chose the previous hotel because of the location (D1) and will choose the next hotel they intend to stay in because of the effective recommendations /advertisements (D9).

Transition Probability Matrix (Table 4.18) is created by dividing each cell in the transition number matrix to the sum of the row in which it is located, and shows the probability of transition from each state to another state.

Table 4. 18. Transition Probability Matrix

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
D1	0,3163	0,2551	0,0102	0,0612	0,0714	0,0510	0,0204	0,0306	0,1531	0,0306
D2	0,0984	0,6230	0,0492	0,0164	0,0492	0,0000	0,0492	0,0328	0,0656	0,0164
D3	0,1429	0,0000	0,5714	0,2857	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
D4	0,0682	0,1364	0,0682	0,4318	0,0455	0,0000	0,0682	0,0909	0,0682	0,0227
D5	0,0400	0,1200	0,0000	0,0800	0,5600	0,0400	0,0400	0,0400	0,0800	0,0000
D6	0,0000	0,0357	0,0000	0,0357	0,0000	0,7857	0,0357	0,0357	0,0357	0,0357
D7	0,1463	0,1951	0,0000	0,0244	0,0000	0,0488	0,3171	0,1463	0,1220	0,0000
D8	0,1667	0,3889	0,1111	0,0000	0,0000	0,0000	0,0556	0,2222	0,0556	0,0000
D9	0,0952	0,2619	0,0476	0,0238	0,0952	0,0000	0,0476	0,1429	0,2857	0,0000
D10	0,1739	0,1087	0,0217	0,1087	0,0652	0,0000	0,0870	0,0435	0,0870	0,3043

Table 4.18 shows the dependency ratio of each element on the diagonal to the factor that is effective in hotel selection. So; ıt can be said that a person who chose a hotel due to "Location (D1)" will choose a hotel for the same reason again in the next hotel selection with a rate of 32%, a person who chose a hotel because of Room and Facility Cleaning (D2) will choose a hotel because of Room and Facility Cleaning (D2) in the next hotel selection with a rate of 62%, a person who chose a hotel due to The Friendly and Qualified Staff at A Hotel (D3) will choose a hotel for the same reason again in the next hotel selection with a rate of 57%, a person who chose a hotel due to Room prices / Special Offers (D4) will choose a hotel for the same reason again in the next hotel selection with a rate of 43%, a person who chose a hotel

because of Beach and Pool (D5) will choose a hotel because of Beach and Pool (D5) in the next hotel selection with a rate of 56%, a person who chose a hotel due to Availability of Facilities for Families with Children (D6) will choose a hotel for the same reason again in the next hotel selection with a rate of 79%, a person who chose a hotel due All-inclusive- Full board (D7) will choose a hotel for the same reason again in the next hotel selection with a rate of 32%, a person who chose a hotel due to Various Activities and Entertainment (D8) at a Hotel will choose a hotel due to Various Activities and Entertainment (D8) in the next hotel selection with a rate of 22%, a person who chose a hotel due to Effectiveness of Recommendations/Advertisement (D9) will choose a hotel for the same reason again in the next hotel selection with a rate of 29%. It can be concluded that which of the factors affecting hotel selection is more important for the participants from these results. For example, it can be interpreted that the Availability of Facilities for Families with Children (D6) is very important for families with children. Because the majority of those who chose a hotel because of the Availability of Facilities for Families with Children (D6) stated that they would choose a hotel for the same reason again.

The emission matrix (Table 4.19) was created by considering which hotel the respondents last stayed at and the reasons for choosing this hotel. V_i in Table 4.19 show the hotels in Table 4.3. While V_i in Table 4.19 show the hotels in Table 4.3, D_i show the hidden states of the model.

Table 4. 19. Emission Matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
D1	38	8	9	3	3	6	4	16	5	5	1
D2	40	3	0	3	0	8	1	1	4	1	0
D3	2	0	1	1	0	1	0	1	0	0	1
D4	29	4	1	1	2	2	0	3	0	0	2
D5	16	2	0	0	1	0	0	5	0	0	1
D6	11	1	6	1	0	0	0	2	0	0	7
D7	21	2	7	2	1	0	0	7	0	0	1
D8	14	2	0	0	0	0	0	1	1	0	0
D9	20	1	4	3	3	1	0	8	1	1	0
D10	39	2	2	1	0	0	1	0	0	0	1

When Table 4.19 is examined, the distribution of the factors affecting preferences according to hotels can be easily reached. For example; 16 people have chosen Altın Orfoz Hotel (V8) for Location (D1). When looking at Ulu Resort Hotel (V3), it was chosen by 6 people due to "Availability of Facilities for Families with Children (D6)".

Each number in Table 4.19 is divided by the sum of the row in which it is located, and thus the Emission probability matrix is obtained. The matrix obtained is shown in Table 4.20.

Table 4. 20. Emission Probability Matrix

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
D1	0,3878	0,0816	0,0918	0,0306	0,0306	0,0612	0,0408	0,1633	0,0510	0,0510	0,0102
D2	0,6557	0,0492	0,0000	0,0492	0,0000	0,1311	0,0164	0,0164	0,0656	0,0164	0,0000
D3	0,2857	0,0000	0,1429	0,1429	0,0000	0,1429	0,0000	0,1429	0,0000	0,0000	0,1429
D4	0,6591	0,0909	0,0227	0,0227	0,0455	0,0455	0,0000	0,0682	0,0000	0,0000	0,0455
D5	0,6400	0,0800	0,0000	0,0000	0,0400	0,0000	0,0000	0,2000	0,0000	0,0000	0,0400
D6	0,3929	0,0357	0,2143	0,0357	0,0000	0,0000	0,0000	0,0714	0,0000	0,0000	0,2500
D7	0,5122	0,0488	0,1707	0,0488	0,0244	0,0000	0,0000	0,1707	0,0000	0,0000	0,0244
D8	0,7778	0,1111	0,0000	0,0000	0,0000	0,0000	0,0000	0,0556	0,0556	0,0000	0,0000
D9	0,4762	0,0238	0,0952	0,0714	0,0714	0,0238	0,0000	0,1905	0,0238	0,0238	0,0000
D10	0,8478	0,0435	0,0435	0,0217	0,0000	0,0000	0,0217	0,0000	0,0000	0,0000	0,0217

The underlying reasons for hotel choices were analyzed using the Transition probability matrix and Emission matrix. Matlab program was used for this analysis. Analysis results are shown in Table 4.21.

Table 4. 21. Probabilities of the Hotels to be Preferred and Hidden Situations

	Observation	Probability (%)	Hidden Situation
None	V1	53,21	D2
Wonasis Resort& Aqua Hotel (5*)	V2	6,08	D1
Ulu Resort Hotel (5*)	V3	6,22	D1
Liparis Resort Hotel& Spa (5*)	V4	3,95	D2
Lamos Resort Hotel (5*)	V5	2,68	D9
Sahil Martı Hotel (4*)	V6	6,07	D2
Hotel Royal Sebaste (4*)	V7	1,78	D1
Altın Orfoz Hotel (4*)	V8	11,37	D1
Marvel Tree (4*)	V9	3,82	D2
Olbios Marina Resort Hotel (4*)	V10	2,40	D1
Marpessa Blue Beach Resort& Spa Hotel (4*)	V11	2,42	D6

For problem 1 of the Hidden Markov model, the next preference probabilities of the hotels were calculated using the Forward-Backward Algorithm. When looking at the results in Table 4.21, it can be seen that the probability of choosing the None option is the highest with 53,21%. It was determined that Altın Orfoz Hotel is the hotel to be chosen with the highest probability (11,37%) because of location (D1). Altın Orfoz Hotel is followed by Ulu Resort Hotel (6,22%) that was chosen because of location (D1), Wonasis Resort& Aqua Hotel (6,08%) that was chosen due to location (D1), Sahil Martı Hotel (6,07%) that was chosen because of room and facility cleaning (D2), Liparis Resort Hotel& Spa (3,95%) that was chosen due to room and facility cleaning (D2), Marvel Tree (3,82%) that was chosen because of room and facility cleaning (D2), Lamos Resort Hotel (2,68%) that was chosen due to the effective recommendations /advertisements (D9), Marpessa Blue Beach Resort& Spa Hotel (2,42%) that was chosen because of availability of facilities for families with children (D6), Olbios Marina Resort Hotel (2,40%) and Hotel Royal Sebaste (1,78%) that were chosen due to location (D1).

The matrix, which shows the hidden situations underlying the preference of 4 and 5 star hotels with beaches in Mersin for the next summer period, is shown in the following Table 4.22

Table 4. 22. Hidden States Underlying Transition Between The Hotels

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
V1	D2										
V2		D1									
V3			D1								
V4				D2							
V5					D9						
V6						D2					
V7							D1				
V8								D1			
V9									D2		
V10										D1	
V11											D6

For problem 2 of the Hidden Markov model, the underlying reasons for the preference probabilities of the hotels, namely the hidden situations, were determined. Viterbi Algorithm was used for the analysis. According to Table 4.22, we can say that the underlying reason for the preference of Altın Orfoz Hotel, is Location (D1) where the hotel is established. It can be seen that Wonasis Resort & Aqua Hotel, Ulu Resort Hotel, Hotel Royal Sebaste and Olbios Marina Resort Hotel are chosen due to their location (D1) as well. The underlying reason for choosing Liparis Resort Hotel & Spa, Sahil Martı Hotel, and Marvel Tree hotels are Room and Facility Cleaning (D2). Unlike other hotels, the underlying reason for choosing Lamos Resort Hotel is the Effectiveness of Recommendations/Advertisement (D9), while the underlying reason for choosing Marpessa Blue Beach Resort & Spa Hotel is the Availability of Facilities for Families with Children (D6).

5. CONCLUSIONS

Turkey is increasing its popularity in terms of tourism day by day and offers different tourism options for both local and foreign tourists, regardless of summer and winter. For tourists, the comfort offered by businesses in accommodation, eating and resting moments is as important as the places they visit. At this point, hotel businesses have enormous duties. Tourism periods are very critical processes in terms of both the economic development of our country and the increase in its popularity by introducing it to the world. The ability of hotel businesses to compete with other businesses depends on many factors. As stated in the content of the study, there are many factors such as location, facility hygiene, facility features, accommodation fees, concepts. Notably, due to the Covid-19 epidemic, room and facility cleaning is the first feature sought in hotel businesses. Considering all these situations, hotel businesses have a great responsibility. In this competitive environment, it is of great importance for hotel businesses to know the next preferences of customers and the reasons for these preferences.

Turkey is a country where tourism activities can be carried out for 12 months, but in this study, an application was carried out on hotel businesses in Mersin, which is mostly preferred for the summer season. Mersin is a city located in the Mediterranean region, which is very popular with its beaches, history and different accommodation options. Although Mersin province has many accommodation facilities, 4 and 5-star hotels with beaches were included in the study so that the study could reach more accurate and definitive results.

The tourism sector in Turkey has been affected heavily by the reason of the Covid-19 pandemic in the period when the study is conducted. For this reason, it is seen that the rate of not choosing any hotel is high in the results of the study. Stopping tourism activities, which are expressed as luxury consumption, significantly reduces the risk of catching Covid-19. In addition, travel bans, halving the hotel capacity, and other restrictive measures have greatly reduced the participation rate of people in tourism activities. It can be considered natural that the percentage of not selecting any hotel for such reasons is high. Furthermore, ıt can be seen that the underlying reason for not choosing any hotel is Room and Facility Cleaning (D2). The extra sensitivity individuals experience in hygiene during the pandemic period also supports the result.

Generally, when choosing a hotel, Room and Facility Cleaning (D2) is one of the most important factors that people pay attention to. Especially in the pandemic environment, most people do not want to stay in hotels because they attach extra importance to the cleanliness factor. People are looking for hygiene and comfort in the hotel rooms like in their house. Considering the reasons for choosing the hotels included in the study, it is seen that the facilities and rooms of Liparis Resort Hotel & Spa (5 *), Sahil Martı Hotel (4 *) and Marvel Tree (4 *) were chosen because they provided the cleaning and comfort that people paid extra attention to during the pandemic period. However, Room and Facility Cleaning (D2) is an important factor as well as a factor that every hotel should pay attention to. Therefore, these hotels selected for room and facility cleaning should change their marketing strategies and focus on other factors that are effective in hotel selection.

Considering the preference rates of the hotels included in the study in the future and the factors affecting these preferences, it can be seen that Wonasis Resort& Aqua Hotel (5*), Ulu Resort Hotel (5*), Hotel Royal Sebaste (4*), Altın Orfoz Hotel (4*) and Olbios Marina Resort Hotel (4*) were chosen due to their Location (D1). When the hotels selected for their location are examined, it is seen that they are established in the most beautiful places of Mersin. Wonasis Resort & Aqua Hotel (5 *) is located close to the city and by the sea. Ulu Resort Hotel (5 *) is far from the city and located at the seafront, where the Taurus Mountains meet the Mediterranean. Hotel Royal Sebaste (4 *) is 45 km from the city center and is close to historical sites in the area. In addition, all rooms are positioned to have a sea view. Altın Orfoz Hotel (4 *) is a seaside hotel where freshwater meets saltwater, which is easy to reach from the city. Finally, Olbios Marina Resort Hotel (4 *) is away from construction and located in a historical area intertwined with nature. It has been determined that these hotels selected due to their location have almost the same location features. Therefore, these hotels must change their marketing strategy to differentiate themselves from the hotels chosen for the same reason like them.

Looking at Lamos Resort Hotel and Marpessa Blue Beach Resort & Spa Hotel, it can be seen that the factors affecting their preference compared to other hotels are different. Lamos Resort Hotel was chosen because of the Effectiveness of Recommendations/Advertisement (D9). In this case, we can say that these hotel customers also recommend it to their family and friends as they are very satisfied with the services of the hotel. It has been determined that Marpessa

Blue Beach Resort & Spa Hotel was chosen because of the Availability of Facilities for Families with Children (D6). When the features of the hotel are examined, it is estimated that the hotel is preferred by families with children because of being a small hotel that everything is close to each other, ıt has a children's playground and animated entertainment, and the pool is adjacent to the children's pool in the hotel. These two hotels can develop their marketing strategies and increase their preference rates in the future by emphasizing their differences.

Looking at the results of the study, it can be said that the 4 and 5-star hotels with beaches in Mersin could not differ from each other, and the reasons for choosing them were very similar to each other. It has been observed that the number of hotels in different concepts with all-inclusive 4 and 5 stars in Mersin is not sufficient and equipped. For this reason, it has been recognized that even people living in this region prefer different cities with more vibrant coastal tourism. Different hotel concepts can also be implemented in Mersin in order to boost tourism and encourage tourists to come.

Looking at the results of the study, it is seen that 4 and 5-star hotels with beaches in Mersin are highly preferable, and individuals who prefer it consider different criteria. Compared to the 4 and 5-star beach hotels in different coastal cities in the Mediterranean and Aegean regions, it is seen that the facilities of the hotels in Mersin are more limited and insufficient in terms of concept. If Mersin has facilities that have more green areas, sandy beaches, sea view and more comfortable rooms, with alternative concepts and spread over wider areas, especially for families with children, it is predicted that the tourism activity of the region will increase and thus it will contribute to the popularity of Mersin in terms of tourism. As a suggestion in the future, this study can be developed and applied to larger populations or in other provinces. For example, hidden reasons underlying the hotel preferences of business and leisure travelers can be determined by using the HMM.

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