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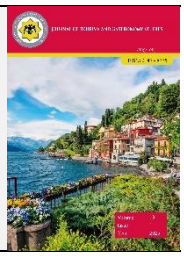

Solution of The Problem of Daily Visiting Routes for Tourist Attractions By "The Travelling Salesman Problem"

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Abstract

In recent years, it has been observed that there has been an increase in demand for urban tourism as a result of the developments in the fields of technological, economic and communication. The city tourism, where visitors participate for a short time, aims to present all the features that make up the identity of the cities to its guests. The guests who come to the cities for daily visits to the touristic destinations leave the city again after reaching the pre-determined points. This tour process can be modelled as a classical traveling salesman problem. Although there is a large literature on the traveling salesman problem, the number of studies on daily touristic visits is limited. In this study, a problem related to the daily visit of 12 touristic destinations determined by tourism professionals for a city in Europe with a population of approximately 200.000 was examined. The problem modelled as traveling salesman problem has been solved with different heuristic methods.

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INTRODUCTION

The problem of finding the shortest path is defined as the traveling salesman problem (TSP). The problem includes the seller and the customers or cities that the seller needs to go and distances between customers or cities are known. In the problem, it is aimed to find the shortest route that will allow the seller to travel from the centre to visit all customers only once and return to the center, which is the starting point.

TSP is used in the solution of many logistics problems such as vehicle routing and distribution problem in real life (Laporte et al., 2000) order picking problem in warehouses (Ratliff & Rosenthal, 1983) (Özçakar et al., 2012) and routing of political party rally program (Ertuğrul & Özçil, 2016).

In the TSP, possible solutions, that is, the best route among the routes, are tried to be found. By means of precise methods that will find the best route, the solution can take a very long time because the number of possible solutions increases exponentially as the number of nodes increases. In this case, heuristic methods that find approximate solutions for the TSP come into play. Heuristic methods used for the TSP are available in the literature. Heuristics for the TSP can be divided into two groups, tour creation heuristics and tour development heuristics. While the first group includes the saving algorithm, the nearest neighbour algorithm, the addition algorithm, the minimum spanning tree algorithm, the second group includes algorithms such as 2-opt, 3-opt heuristics, evolutionary algorithms, genetic algorithm, ant colony algorithm, tabu search algorithm. The aim of this study; rather than a methodological contribution, it is the modelling of the problem of creating daily tourism routes, which is a real-life problem, through the application of the TSP in the field of tourism.

In the literature, there are studies on the use of the TSP in the optimization of tours created in tourism trips. For instance (Zhu & Lan, 2020), a key route planning model for natural hot spring tourism was designed with a study in which a multi-purpose optimization algorithm was used, in which the route planning results for controlling time and transportation cost were integrated by finding the main routes for natural hot spring tourism in coastal cities (Tlili & Krichen, 2021). To solve the problems of travel planning, which is a time-consuming and demanding task for tourists; we propose a two-step metaheuristic method in which points of interest matching user preferences are selected and grouped into clusters according to their starting and ending locations, and the routing problem is solved for each cluster to create optimal routes. TripAdvisor scoring was used to identify nodes on a route consisting of 9+1 points in Tunisia. However, in both studies, expert opinion and daily tour constraints were not taken into account to determine the points to be visited in a TSP tour. In this study, the daily tour constraint was considered and expert opinion was sought to determine the most important locations that should be included in the tour.

In this study, daily visit routes for urban tourism points belonging to a city with a population of approximately 200,000 are discussed. Guests who come to this city for daily touristic visits determine the route they will follow based on their knowledge and experience. The aim of this study is to create and optimize daily visit routes covering urban tourism points by using existing TSP solution methods.

In this study, two algorithms in the WINQSB package program were used. These are the Nearest Neighbourhood Algorithm and the Cheapest Insertion Algorithm, which are the TSP's tour construction heuristics. The reason for using these algorithms in the package program is that, they can be easily used by practitioners in real life. In addition to these two algorithms, the evolutionary algorithm, one of the tour improvement heuristics, was developed in the

Microsoft Excel package program.

Urban Tourism

Tourism, which has become one of the locomotive sectors of the world economy with its rapid development in recent years, is an important tool for the economic development of developing countries. The tourism sector, which economists call the "flueless industry", plays an important role in the economy due to the foreign exchange income it provides and the share it receives from the national income of the countries. The tourism sector, which creates new job opportunities, fills an important area for countries with high unemployment (Ateş, 2013).

As a result of the changes and developments that have occurred over the years, the tourism sector has become indispensable for countries. Tourism is an important source of income for countries, directly affecting the balance of payments, being a valuable employment area, creating foreign exchange flows, etc. in addition to its economic effects, its contribution by creating cooperation with different sectors is increasing its importance (Demir et al., 2020). After the Second World War, the rapid development of transportation and communication technologies, as well as the changing working life in parallel with the rapid increase in production, increased the leisure time of people supported by disposable income. With the development of tourism, the growth of the travel market, the development of alternative tourism products and the diversification of tourism have almost made it necessary for countries that want to increase the level of contribution in the tourism economy. It is also known that many countries or touristic destinations produce policies to spread tourism throughout the year and to offer tourism products to different audiences with different types of tourism (Kaya & Keleş, 2022).

Today, people's expectations, wishes and preferences from tourism are changing due to the increase in living standards, income, social rights, and the distress and stress brought by urbanization and business life (Demir et al., 2020). In addition, as a result of the rapid developments in science and technology in the world, the idea of a longer and healthier life has been strengthened and people have sought alternatives to solve their health problems. In these pursuits, there are also efforts to reach health services that people cannot obtain from the countries they live in for various reasons by going to different countries. These alternative searches and developments have increased health-oriented travels and caused the emergence of health tourism, which is a new branch for the tourism sector (Bayrak & Gönenç Güler, 2022).

Touristic activities, which contribute to the social, cultural and economic development of countries and the development of mutual relations, continue increasingly due to the increase in transportation options and the development in mass media. In order to meet the increasing tourist demand, alternative tourism activities are being developed and new touristic destinations are being created, and research on culture, city and faith tourism are increasing day by day in order to achieve this goal (Karabulut & Kaynak, 2016).

The areas whose natural and cultural textures are preserved in the increasing population and urbanization in cities emerge as areas that allow individuals to move away from the mixed urban structure. Areas that offer different types of landscapes with their natural and cultural texture tend to offer different services and experiences to both city users and visitors, such as peace, excitement, education, recreation, inspiration, and a sense of well-being. In these areas, users are looking for different destinations that include activities such as socialization, art, sports, health, culture, education and entertainment (Çorbacı et al., 2022).

With the spread of globalization, the increase in travel opportunities and the ease of reaching from one place to another, cities have started to host more tourists by developing new tourism strategies. Cities aiming to increase their income from tourism by promoting their natural, historical, cultural and architectural values in various ways have started to produce new touristic objects as well as trying to improve their existing tourism potential (Akman & Güler, 2021).

The city is a living space that includes the socio-psychological life as well as the geographical space that regulates the degree and distance of human relations that compels people to human. The city as a living space is one of the most important and at the same time complex spatial forms produced by man. In this sense, the city is together with a natural geographical area; It expresses itself as a sight worth seeing with its buildings, streets, roads, pavements, bazaars, entertainment places, museums, religious, economic and political structures. Tourism, on the other hand, is a travel activity that includes "escape and orientation", in which people participate in holiday, entertainment, listening, culture and faith (Karabulut & Kaynak, 2016).

Although the emergence of tourism in the world dates back to the 19th century, the expectations for the contribution of tourism to the urban economies became a topic on the agenda of local governments after 1980. Urban tourism is a type of tourism carried out in metropolitan cities. The interest in "Urban Tourism", which includes vacationing, obtaining historical and cultural information and experience, watching sports events, participating in artistic activities, visiting friends and relatives, shopping and business trips, is increasing rapidly in the world. (Karabulut & Kaynak, 2016).

Increasing the awareness of cities and ensuring that they gain economic value with this increase is possible by revealing their unique features and using them in their promotion. From this point of view, the elements defined as the physical face of cities should be evaluated as a whole (Şayin & Dalkıran, 2020).

Urbanization and tourism movements emerged at approximately the same time in 4000 BC. While the increase in urbanization increases the touristic activities, the development of tourism also has some effects on the cities. Visits to cities provide significant economic benefits (Sezen & Külekçi, 2020). Today, cities with the opportunities provided by the 4th industrial and technology revolution; it has begun to transform into a set of living cultural spaces that tell their own stories (Özdemir, 2018).

An important trend in tourism in recent years is the efforts to highlight locations as touristic values, not countries. In this context, the presentation of cities as tourism brands has focused attention on urban tourism (Ateş, 2013).

The development of transportation and communication opportunities and the increase in the level of welfare have also brought about changes in people's holiday understanding. The increase and cheapening of flights and the ease of access to information have made it interesting to organize short tours to escape from their daily routines, especially for people living in cities, without waiting for the summer holidays. Traveling and staying in an easily accessible and safe city on weekends or short holidays are the touristic activities preferred by people around the world. Tourists participating in these trips, which are called city tourism, they visit cities for various purposes such as visiting the streets that reflect the socio-cultural structure of the society, seeing the architectural structures, visiting the museums bearing traces of history, learning about the life and traditions of the local people, attending theatres, concerts and festivals, tasting local delicacies, visiting entertainment centres, going shopping, following international sports

competitions, making business trips, visiting friends and relatives (Kaya & Keleş, 2022).

According to the World Tourism Organization, urban tourism is "tourism activity carried out in urban areas with non-agricultural economy and advanced transportation features such as management, production, trade and services. Cities are among the fastest growing tourism destinations all over the world and especially in Europe. Approximately 50% of city tourists are in the upper income class, while two thirds are in the upper education group (Kaya & Keleş, 2022).

City tourism is entertainment trips that are carried out not only for accommodation but also for the purpose of visiting a city directly. For the contemporary traveller, cities have become a destination in their own right, not just a point of entry, exit or transit. The fact that those who participate in city tourism generally prefer weekend visits complements the occupancy rate received by accommodation businesses from business trips on weekdays (Kaya & Keleş, 2022).

Since the majority of tourists live in cities, they are more inclined to prefer cities for their travels. Thanks to internet-based services, access to information and making online reservations became easier, increasing participation in city tourism. With the ease of mobile access to information during travels, tourists have begun to seek more authentic experiences. The desire of the tourists to experience the city by living like the locals ensures the development of a different protection status in the cities. Although city tourism can be applied in all destinations that meet the criteria of being a city, it is a type of tourism that is carried out in large cities at the metropolitan scale (Kaya & Keleş, 2022).

The Traveling Salesman Problem

The Traveling Salesman Problem (TSP) is an important optimization problem that calculates the shortest path, the route, on more than one node (cities) with direct routes between them, on the condition of not passing through a node again and visiting all nodes, while returning to the node from which it started, starting from a starting node. This problem was described in the 1800s by mathematicians W. R. Hamilton and Thomas Kirkman (Saiyed, 2012). TSP is a type of mathematical programming problems. It is the problem of determining the tour that allows a traveling salesman to travel from a central location, after visiting the cities he needs to go only once, to reach the city he started again at the end of a journey with the shortest total length. The TSP is the problem of finding the shortest (least costly) route back to the starting node for n nodes (cities) given a TSP, provided that each node is visited once. This structure, which is extremely easy to define, but an NP-Hard optimization problem to solve; considering the points placed on a graph and the costs between them, it is defined as navigating all the nodes on the line with the most affordable cost, provided that each node is visited only once and the solution to this problem is also seen as a Hamilton Cycle (Potvin, 1996). TSP forms the basis of routing problems. The main objective addressed in the TSP is to minimize the cost of the firm or the total distance (time) travelled by travellers (Uzun, 2021).

In fact, the seller aims to keep the time loss and cost to a minimum by determining the cities he/she may visit during the journey. Many different methods have been proposed to obtain the optimum or closest optimum result for TSP (Carter & Ragsdale, 2006). Today, the competitive markets brought by the developing technology and globalization force the enterprises to use scientific methods rather than based on experience while continuing their activities. Businesses provide cost savings and competitive advantage through more effective methods obtained with

scientific approaches.

In order to apply this problem, it is necessary to know the distances from each point to all other points. If the total number of points is n, there are (n -1) points for the first point, (n -2) points for the second point, and (n -3) points for the third point. Here n denotes the size of the problem and the possible number of rounds for the problem (n -1)! . As can be calculated, it is possible to reach the exact solution in cases where the number of points is low, while the number of alternative solutions for the problem increases rapidly as the number of points increases and it takes a lot of time to find the optimum solution. For this reason, optimum or near-optimal satisfactory results can be obtained in a short time by using heuristic and meta-heuristic methods (Çolak, 2010).

TSP has been a solution by adapting to some problems in almost all fields, especially engineering and statistics. Many solution methodologies have been developed for TSP from past to present (Al-Badri & Aydoğan, 2017).

In today's competitive environment, distribution costs and timing are among the important factors affecting the profitability and competitiveness of businesses. For this reason, by using scientific and technological methods in the determination of distribution routes, businesses will gain significant advantages by providing logistics cost savings, increase their profit margins, and at the same time, some resources in the country's economy (oil, labour, time, etc.) will be used more efficiently.

In recent years, with the continuous increase in competition, customer satisfaction has become a factor that should be considered as much as cost for companies. In today's conditions, especially in the COVID-19 process, which is experienced all over the world, the fact that e-commerce and virtual markets are widely used is an indicator of the importance of customer satisfaction. This situation has brought the concepts of humanitarian logistics and customer-oriented logistics to the agenda. On the basis of humanitarian logistics, there is a time frame for each customer from the request to the fulfilment of the service, in other words, the service process and its duration (Uzun, 2021).

Although TSP seems simple and understandable in terms of definition, the effectiveness of classical mathematical methods decreases as the number of nodes in the problem increases in terms of solution approach, and therefore, heuristic algorithms are often preferred in TSP solution (Karagül, 2019).

TSP can be defined as follows. *G=(V,E)* or *G=(V,A)* a graph, *V={1,2,3,…,n}* set of nodes, $E = \{(i,j): i,j \in V, i < j\}$ is the edge set, $A = \{(i,j): i,j \in V, i \neq j\}$ is the arc set. For each (i,j), there is a non-negative cost c_{ij}, which represents the cost of going from i to j.

In practice, $C = [c_{ij}]_{nxn}$ is the cost matrix. Here, the cost path can represent time or a different type of cost. According to the structure of the cost matrix, there are two different types of TSP. If the cost matrix C is symmetric, that is, G is an undirected graph, the problem is called the Symmetric Traveling Salesman Problem (STSP) and is denoted by *G=(V,E).* When the nodes are considered as cities, the departure and return distances between the two cities are the same in STSP. The mathematical model of the STSP is as follows (Matai et al., 2010).

Purpose Function:

$$\text{Min} \sum_{i<j}^{n} c_{ij} * x_{ij} \quad (1)$$

$$\sum_{i<k} x_{ik} + \sum_{j>k} x_{kj} = 2 \qquad (k \in V) \quad (2)$$

$$\sum_{i,j \in S} x_{ij} \leq |S-1| \qquad (S \in V, 3 \leq |S| \leq n-3) \quad (3)$$

$$x_{ij} = 0 \text{ or } 1 \qquad (i,j \in E) \quad (4)$$

In the model, (1) indicates the objective function, the number (2) is the degree constraint. According to this constraint, if there is an arrival from a node i to a node k, there must be a departure from this node k to a node j. The next constraint is the sub-round elimination constraint (3). According to constraint (4), if going from i to j in the optimal round, x_ij=1, if not, x_ij=0. If constraint (3) is not taken into account, it will be seen that the problem is actually an assignment problem. Constraint (3) is the sub-type elimination constraint of Dantzig, Fulkerson, and Jhonson (1954) who created the model. This constraint prevents the formation of closed tours, ie sub-tours, that do not contain the warehouse. Here S is a subset of V, |S| is the number of nodes in S.Let there be n nodes in S (|S|= n),with S ∈V. In this case, n nodes in S will be able to create at most (n-1) connections among themselves. When the number of connections is more than (n-1), a sub-round is formed in S (Dantzig et al., 1954).

Literature

In order to conduct a comprehensive literature review, a large-scale study was conducted, and a detailed analysis was made of studies published in Turkish and English in peer-reviewed academic journals whose full texts could be accessed between 2003 and 2023.

In order to be able to choose a large-scale and unbiased literature; keywords "optimization", "optimizasyon", "gezgin satıcı problemi", "gsp", "traveling salesman problem", "tsp", "turizm", "tourism", "şehir", "urban", "city" used. The number of literatures that emerged as a result of the searches made according to the constraints determined by keywords in the databases determined using the EBSCOhost system infrastructure and at the specified time intervals are as follows: (Keywords were searched in the “Title/Title”, “Abstract/Abstract” and “Keywords/Keywords” sections of the articles).

("optimization" OR "optimizasyon" OR "gezgin satıcı problemi" OR "gsp" OR "traveling salesman problem" OR "tsp") AND ("turizm" OR "tourism") 600 ARTICLES HAVE BEEN REACHED.

("optimizasyon" OR "optimization" OR "gezgin satıcı problemi" OR "gsp" OR "traveling salesman problem" OR "tsp") AND ("turizm" OR "tourism") AND ("şehir" OR "urban" OR "city") 95 ARTICLES HAVE BEEN REACHED (THE NUMBER OF REVIEWED ARTICLES IS 45 BY CONSEDERING REPEATATION OF ARTICLE AND LANGUAGE RESTRICTION).

Tablo 1. Literature table

1	(Riegels, at al., 2011)	In the implementation study on the resource costs of meeting the ecological status requirements, carried out in the north of Greece; using the Info-Gap decision analysis framework, the effect of uncertain input values on model results is estimated.
2	(Zhang & Huang, 2014)	Spatial analysis was carried out using random aggregation and grid dimension in the study, which was carried out to help comprehend the spatial nature and interrelationship of tourism activities, which form the basis for the efficient use of tourism resources and the proper regulation of spatial distribution.
3	(Yiakoumettis, et al., 2014)	In this study, which is proposed as a correction strategy that improves weight estimates by making use of metadata interrelationships, a genetic optimization algorithm is used to select the user's most preferred routes based on a multi-criteria minimization approach.
4	(Gaofu, 2016)	This is a case study of structural optimization for The Thousand-Island Lake National Forest Park with a sustainable management approach.
5	(Kang, 2016)	In this study, proposed BP Neural Network based on enhanced particle swarm optimization, the tourism environment carrying capacities of some cities in China were estimated.
6	(Sun, Liang, Qu, & Wu, 2016)	A new visualization technique called route zooming is presented in this study, which seamlessly embeds information into map systems to visualize spatial and temporal data without obstruction. The technique has been applied in two examples, including an interactive metro map for urban tourism and illustrative maps highlighting information on extended roads to prove its viability.
7	(Xianhong, Zhidong, & Haohao, 2017)	In this study, which will be useful for promoting land use pattern optimization in the Southern Jiangsu Developed Regions, a high precision regional land use map was developed using artificial interpretation methods based on SPOT and TM satellite detection images.
8	(Sun & Hou, 2021)	Based on panel data from 41 cities in the Yangtze River Delta from 2008 to 2017, a system of assessment indicators for urban tourism eco-efficiency was established. In addition, the modified gravity model and social network analysis have been introduced to explore the spatial network structure and evolutionary trend of tourism eco-efficiency**.**
9	(Nanchang Jiahao & Chaowen, 2018)	It is a case study on the implementation of old town planning based on the concept of smart cities.
10	(Wang, Cao, Li, & Gao, 2019)	It is a study that systematically analyses accessibility via car and public transport travel modes to 56 scenic spots in Xi'an City, China, using spatial analysis methods and modal accessibility, with Baidu Maps API application.
11	(Komorowski & Holderna-Mielcarek, 2019)	In the study, which was carried out by researching among local tourism experts and based on theoretical solutions and action proposals in the cities of Poznan and Wroclaw, it was aimed to determine the functions of mass tourism and over tourism and to explore the optimization possibilities of solutions that allow to prevent over tourism levels.
12	(Wenya, 2019)	This is a study in which the spatial distribution status and spatial network structure of 56 tourist attractions rated AAA and above in Binzhou City were examined using the Geographical Information System spatial analysis tool through nearest distance, connection, accessibility and compactness analysis.
13	(Herlangga & Basuni, 2019)	In this study, which aims to give stakeholder management recommendations for a particular region, research data were collected through interviews and questionnaires. The research was also conducted by Reed et al., who took part in the stakeholder analysis. It was made to compare the method with Driscoll and Starik methods.

Tablo 1. Literature table (cont.)

14	(Chen, et al., 2019)	In this study, in which cluster analysis, importance measurement of nodes and routes and settlement optimization model are established, the idea of ecological highway planning is put forward based on practical problems.
15	(Wlodarczyk & Duda, 2019)	In this study, in which the analysis was made using the example of Łódź, the third largest city in Poland, the role of novels in shaping the image of a city and its effect on choosing it as a tourist destination were evaluated.
16	(Montezuma & McGarrigle, 2019)	Based on 20 in-depth interviews with economic experts related to investment and lifestyle migration, in which the motivations and aspirations of international overseas housing investors are explained, this study aims to understand buyer motivations and the current attractiveness of the city. The results reveal the continuing importance of lifestyle motivations related to quality of life, culture, amenities and climate, both directly and indirectly.
17	(Wu, 2019)	In the study, in which the SWOT analysis method was applied, an analysis was carried out to accelerate the development of low-carbon industry in Zhaoqing City, transform the way of economic growth, and promote industrial transformation and upgrading.
18	(Nolasco-Cirugeda, Marti, & Ponce, 2020)	In this study, which aims to show the relevant role of sustainable urban design for the development of an effective coastal tourism product, the special conditions, facts and regulations that led to the current urban design of the city of Benidorm are presented and the main features of the urban plan that contribute to the sustainability of the model are analysed.
19	(Zhu & Lan, 2020)	In this study, in which a coastal road planning model is proposed to control time and transportation costs for spa tourism, the route information format was determined by filtering the natural spa tourist nodes in the coastal cities. In the study, in which the results of route planning are integrated and multi-purpose optimization algorithms are used to find the main routes of natural spa tourism in coastal cities, the design of the key route planning model for natural spa tourism in coastal cities has been carried out.
20	(Su, 2020)	It is a case study on the design of public spaces of commercial complexes in coastal tourism cities.
21	(Gan, Jiang, & Zhu, 2020)	In order to show how high-speed trains, affect regional carbon dioxide emissions, this study uses the modified STIRPAT model by combining it with actual data on the high-speed train passenger flow volume of the Beijing-Guangzhou high-speed train Hunan section.
22	(Yang, at al., 2020)	Based on the evolutionary optimization algorithm NSGA-II, this study, in which the core stakeholders are optimized to meet their tourism needs and the most appropriate solution set is selected according to the preferences of the decision makers, is taken as an example of Lanzhou City, a semi-arid river valley city, and multi-scenario and time series diversity perspectives. based analysis was carried out.
23	(Luo, at al., 2020)	A multi-objective evolutionary algorithm, MOEA, is used in the study, where a new multi-objective simulation and optimization (S/O) model is proposed to find an optimal extraction strategy that balances the competitive relationship between resource output and groundwater extraction.
24	(Li, et al., 2021)	In the study, which deals with Beijing as an empirical analysis, it is aimed to evaluate the accessibility of multimodal transportation facilities to suburban tourist attractions, on the basis of the detailed needs of tour transportation planning and urban development. Based on multi-source data and GIS network analysis method, an accessibility model of community-scale commuter tourist attractions was constructed by combining the population with cars, public transport, and bicycles with average shortest travel distances (ASTD) or average minimum travel time (AMTT).
25	(Pashovaa, et al., 2021)	This is a case study using drones for landslide mapping in the coastal region of northern Bulgaria.

Tablo 1. Literature table (cont.)

26	(Xue, et al., 2021)	In order to make suggestions for the optimization of the cycling environment in Qingdao, the IPA analysis method was used in the study, which revealed the aspects of developing the characteristic cycling route of coastal tourism.
27	(An, Lin, Li, & He, 2021)	Focusing on helping national or regional governments to make dynamic decisions about restricting and improving intercity multimodal travel services, this study defined the effects of intercity traffic on the spread of COVID-19 and the regional economy and developed an online optimization model.
28	(Masoudi, et al., 2021)	In this study, in which the optimal spatial development of various land use types is determined in the Iranian city of Qaleh Ganges, the achievements regarding the use of multi-criteria assessment and multi-purpose land allocation decision-making tools are shown.
29	(Yapıcı & Özden, 2021)	A qualitative study in which the websites and social media accounts of accommodation establishments in Samsun were analysed by content analysis.
30	(Han, Cheng, Cui, & Xi, 2021)	Considering the city of Dunhua, located in an ethnic region known for its tourism on China's border with North Korea, this study aimed to enable the optimization framework of a comprehensive tourist toilet layout based on Holling's concept of resilience.
31	(Xudong, Haiming, & Xiaoqiao, 2021)	In the study, which deals with the tourism spatial structure of the urban agglomeration in the Greater Bay Area region, the tourism source of the urban agglomeration, the tourism economy and the development of the excellent transportation network are analysed.
32	(Mor, Fisher-Gewirtzman, Yosifof, & Dalyot, 2021)	In this study, in which a tourism walking route is analysed in terms of three-dimensional visibility that measures its attractiveness regarding user perception, a comprehensive evaluation process is proposed and illustrates the use of Flickr, a social media photo sharing site popular with travellers sharing their tourism experiences.
33	(Tlili & Krichen, 2021)	In the simulated study to solve the touristic trip design problem, a tempering-based recommendation system is presented.
34	(Fang, Zeng, & Namaiti, 2021)	In the study, in which visual sensitivity was evaluated by selecting the Wudadao Historic Site, a multi-criteria evaluation method was used and a comprehensive model was created.
35	(Arbolino, et al., 2021)	In this study, which aims to apply a new approach to the selection of projects to be financed by the public administration in order to maximize the efficiency of public resource allocation, a case study of an Italian Public administration whose purpose is to support the attractiveness of urban areas is examined.
36	(Demirel, Gönül-Sezer, & Pehlivan, 2022)	In this study, an alternative approach based on system dynamics (SD) method is presented to examine the complex dynamic and nonlinear structure of wastewater treatment plant site selection and network design problems, in Antalya, a densely populated industrial and tourism region located on the Mediterranean coast of Turkey. Designed for the city.
37	(Feng, Zhang, & Dong, 2022)	In the study, which aims to map the reliable transmission task of wireless sensor networks, the discrete particle swarm optimization algorithm is used for the mapping problem of wireless sensor networks.
38	(Ying, et al., 2022)	Evaluating land use data from 2000 to 2020, the dynamic changes in Zhangjiakou, including land use dynamics, land use transfer matrix, landscape vulnerability, landscape degradation, ecosystem service value, tourism ecological service value, and other aspects are comprehensively analysed.
39	(Li Z. , 2022)	This study presents an energy efficient cold landscape study that analyses the emerging problems in ecological landscape design of cold urban settlements and makes algo-based design for group intelligence.

Tablo 1. Literature table (cont.)

40	(Phu, Fujiwara, & Le Dinch, 2022)	In the study in which the optimization and feasibility of a solid waste management model was made; the efficiency of the collection system, the improvement of the recycling application, the consensus of the stakeholders, the suitability of the treatment and the optimization of the economic benefits are analysed.
41	(Zhao & Ren, 2022)	In the study, in which a two-level programming model is proposed to solve the network optimization scheme, it is aimed to protect and plan historical regions based on the perception of the Internet of Things.
42	(Xie, Meng, Cenci, & Zhang, 2022)	The study, which includes 1470 villages on the national list of beautiful leisure villages in China from 2010 to 2021, summarizes the rural development law, clarifies the factors affecting rural tourism development, and presents a model experience powered by rural tourism.
43	(Zhang & Long, 2022)	In this study, which is based on the theory of institutional complexity, China's urban business environment evaluation index system is created and the influencing factors are analysed with the NCA method.
44	(Yang, Zhang, Liu, & Sun, 2022)	Bibliometric methods and city/urban tourism literature were used in this study, which proposes a tourism-industrial complex view based on a synergetic perspective to clarify the systematic features of urban tourism in an integrated and sustainable way.
45	(Weng, Li, & Li, 2022)	In this study, in which ArcGIS 10.5 was used as the main analysis tool to analyse the temporal and spatial distribution of A-level tourist attractions in the Chengyu Region, factor analysis and interactive analysis were performed on the factors affecting the distribution of tourist attractions with the geographic detector model.

Even though Table 1 shows 45 articles that were accessed according to the specified restrictions, it can be said that some of them are included here only due to filtering restrictions and their relevance to the subject is not sufficient.

Application

In this study, daily visit routes for urban tourism points of a European city with a population of approximately 200,000 are discussed. Although there are many touristic destination points in the aforementioned city centre, the number of points that can be visited daily is limited in terms of time. Guests who come to the city for daily touristic visits determine the route they will follow, based on their knowledge and experience. In determining these points to be used in the study; Tourism company owners, tourism guides and academics are the people who have the best information about the must-see spots in a day. In order to reach the tourist guides among these people, the Provincial Directorate of Culture and Tourism was reached and information was requested about the contact addresses of the tourism guides with licenses operating in this destination and the tourism destinations in the city centre. In addition, the academicians working in the tourism departments of the Regional University were also interviewed. As a result of this process; interviews were conducted with academicians working in the field of tourism, licensed tourism company officials operating in the city centre and the tourist guides having the license and as a result, visiting points were determined.

Experts were asked to score each destination between 1 and 5 where 5 is the most important and 1 is the least important destination. Among the experts six of them completed the evaluations. Due to experts' evaluations, the destinations were listed in descending order according to their total points taken from the six experts. In the last stage the first 12 destinations in the list are used for the study.

The table showing the scores of these visit points is as follows (Table 2).

Tablo 2. Visiting points

Visiting points	Total score given by 6 experts
1	30
2	30
3	28
4	26
5	26
6	26
7	25
8	25
9	20
10	20
11	19
12	18

The table showing the distances between these visiting points is as follows (Table 3).

Tablo 3. Distances between visiting points

DISTANCES	1	2	3	4	5	6	7	8	9	10	11	12
1	0	4,1	2,6	4,5	1,4	2,4	1,6	1,1	1,2	18,2	6,9	5,5
2		0	5,6	7,5	2,8	5,5	7,4	3,8	5,4	21,2	3,6	9,3
3			0	2,6	3,7	4,5	2,8	3	3,2	18,4	7,1	4,5
4				0	5,1	6,8	5,1	4,7	5,4	16,8	7,7	5,5
5					0	2,8	3,3	1	2,6	18,6	6,3	6,7
6						0	3,4	3,2	1,6	20,4	9,1	7,7
7							0	2,8	2	19,3	8	4,1
8								0	2,8	18,1	6,8	6,1
9									0	19,5	8,2	5,8
10										0	22,2	21,2
11											0	10,2
12												0

For 12 determined points, the route that will give the shortest path has been tried to be obtained by using the existing TSP solution methods.

In this study, two algorithms in the WINQSB package program were used. These are the Nearest Neighbourhood Algorithm and the Cheapest Addition Algorithm, which are TSP's tour creation heuristics. The reason for using the two algorithms in the package program is that it can be easily used by practitioners in practical life. In addition to these two algorithms, the evolutionary algorithm, one of the tour development heuristics, was created in the Microsoft Excel package program.

Nearest Neighbourhood Algorithm; It is the simplest among those used for TSP. In the first stage, a node is selected as the starting point, in the second stage, the closest node to the selected node is selected and included in the tour, and always the closest node is selected and included in the tour, starting from the last selected node. This procedure is repeated until there are no nodes that are not included in the round and the round is completed by combining the last selected node with the first selected node (Laporte, 1992).

In the addition algorithm, a round consisting of two nodes is first created. The second stage is adding to the current round. An addition is made to the current round so that it gives the best result. Here, different procedures can be followed in addition. For example; One of the different procedures can be chosen, such as adding the node that will form the shortest round or adding the node closest to the round or the farthest node, adding the node that will form the highest angle (Laporte, 1992). In addition to heuristic approaches, various metaheuristic algorithms are also used

in TSP solution. One of these metaheuristic approaches is evolutionary algorithms. The point on which evolutionary computational methods are based is the theory of natural selection. The basis of evolutionary algorithms is the creation of stronger solution alternatives in each iteration. Genetic Algorithms are among the evolutionary algorithms.

Evolutionary algorithms are used in computer-based problem solving. In an evolutionary algorithm, an initial population is first created. The adaptation of each individual in the population is measured by a fitness function. The fitness function can be a very complex function or a very simple one. Individuals in the population produce new offspring at each iteration by breeding. Which individuals produce offspring is a choice. Offspring are formed by reproduction. Reproduction or reproduction operation is done by cross information or gene exchange between parents. In addition, the entire population mutates. The number of individuals in the population increased with offspring from parents. Determining which individuals will remain in the population and which individuals will be eliminated; relocation should be done. In the next step, it is determined which individuals will remain in the population and which individuals will be eliminated (Sivanandam & Deepa, 2008).

The results of the Nearest Neighbourhood Algorithm and the Cheapest Insertion Algorithm were obtained with the WINQSB program. In the WINQSB program, the Nearest Neighbour Heuristic Methods to the TSP were selected. In the WINQSB program, the Cheapest Insertion Heuristics was selected by logging in to the TSP. The reason why these algorithms are chosen in practice is because they are algorithms included in package programs. Thus, practitioners will be able to use these algorithms practically.

TSP was solved in the MS Excel program as stated by Esen (Esen, 2008) and applied by Çetin and Özçakar (Çetin & Özçakar, 2019). This solution was realized by using the expansion (evolutionary algorithm) option of the MS Excel program. Here, the problem is solved by modelling it as a genetic algorithm, one of the evolutionary algorithm methods. The parameters for the Genetic Algorithm were chosen as convergence 0.0001, mutation rate 0.075 population size 100 random root 0 and time limit 30 without development.

The results obtained with three different algorithms are shown in Table 1. According to these results, the shortest distance was obtained with the Genetic Algorithm.

Tablo 4. Traveling salesman algorithms

Algorithm	**Route**													**Cost (Distance)**
Cheapest Insertion Heuristic	**5**	**11**	**2**	**6**	**9**	**7**	**12**	**3**	**4**	**10**	**1**	**8**	**5**	**67,30**
Nearest Neighbour Heuristic	**1**	**8**	**5**	**9**	**6**	**7**	**3**	**4**	**12**	**2**	**11**	**10**	**1**	**73,90**
Genetic Algorithm	**3**	**4**	**10**	**11**	**2**	**5**	**8**	**1**	**6**	**9**	**7**	**12**	**3**	**64,70**

Conclusions

With the results obtained, the modelling of the points to be visited for urban tourism with TSP; It has been shown that it can be done in a simple way using Nearest Neighbourhood Algorithm, Cheapest Addition Algorithm and Evolutionary Algorithm. The limited number of literatures on creating and optimizing daily tours with TSP is valuable in terms of the contribution of the study to the literature on the tourism sector. One of the important aspects of the study is that the locations on the tour are determined by expert opinion.

Practically, the study offers an opportunity to tourism decision makers with the Excel package program, whose

sectoral contribution can be found very easily, and it also gives the chance to make this optimization with WinQSB, which is also a partially easy-to-use package program. These suggested methods can be used for many different tourism tours.

Consequences of this research can provide a practical support for decision makers in tourism sector. The solutions for routing can be obtained easily by the package programs. According to the solutions, total distance and sorting of the destinations can be compared by the decision makers.

As there is limited research regarding making daily routes for tourism using analytical models, it is thought that this research will contribute to the literature.

The lack of studies with different and better algorithms and exact solution methods can be shown as a limitation. The reason why it is tried with algorithms that give better results can be shown as providing users with the opportunity to apply by using simple package programs. Because different package programs will be required for exact solution methods. Using these mentioned programs is more complex and solution times are relatively longer.

As the literature regarding comparing different routes of TSP in tourism sector, it is thought that the current research makes contribution to the literature.

However there are some limitations regarding the research. First of all the time period which will be spended in each destination is not regarded. This can be seen as a limitation of the research. It is recommended that the time spent in each destination should be taken in to account in future research.

Besides this the traffic jam which may be occur between destinations in metropoles is not considered as this research is conducted in a small city. This may be regarded as a limitation of the research as well. In following research traffic jam between destinations may be considered using different TSP models.

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