MULTI-CRITERIA DECISION MAKING AND THE CHOICE OF HOTELS IN TOURISM SECTOR

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ABSTRACT

In recent years, the choice of hotels for the holidays, has become more important to people. Therefore, a rapid change and improvements lived in tourism sector for achieving the increasing level of customer needs. In this paper, firstly decision theory and decision types are explained and the main features of multiple criteria decision making (MCDM) problems are summarized followed by a list of typical techniques used in MCDM analysis. Then the subject of MCDM is briefly demonstrated with an example which is the choice of hotels in tourism sector. In this example, five different hotels in Antalya, Balıkesir and Aydın cities were estimated by using three different multi criteria decision- making methods: Analytic Hierarchy Process (AHP), TOPSIS and VIKOR which are the most widely used MCDM methods. The main purpose of this study is to determine the optimum hotel alternative by expressing the weighting grades of selection criteria and the relationship between criteria and alternatives. Surveys are made with hundred people for weighting the criteria. Also five criteria for the selection of hotels are specified which are room fee, food diversity, cleaning service, security service and proximity to the sea. Finally relevant references are listed.

Keywords—Criteria, MCDM methods, selecting a hotel alternative

INTRODUCTION

In today's rapidly changing, increasingly difficult living and working conditions are forced to people, institutions or businesses constantly "good" and "success" to make a decision. To survive in such an environment, gain competitive advantage and making healthy decisions is a necessity to maintain it. Traditionally, in arriving at a decision, collected data related to the decision-making process and by analyzing the results intiutively. But now in many cases, to be able to succeed decisions an alternative way of behavior are evaluated with the support of scientific decision-making techniques. Multiple criteria decision making (MCDM) refers to making decisions in the presence of multiple, usually conflicting, criteria. MCDM problems are common in daily life. In personal context, a house or a car one buys may be characterised in terms of price, size, style, safety, comfort, etc. In business context, MCDM problems are more complicated and usually of large scale. For example, many companies in Europe are conducting organisational self-assessment using hundreds of criteria and sub-criteria. Purchasing departments of large companies often need to evaluate their suppliers using a range of criteria in different area, such as after sale service, quality management and financial stability. The development of the MCDM discipline is closely related to the advancement of computer technology. In one hand, the rapid development of computer technology in recent years has made it possible to conduct systematic analysis of complex MCDM problems. On the other hand, the widespread use of computers and information technology has generated a huge amount of information, which makes MCDM increasingly important and useful in supporting business decision making. There are many methods available for solving MCDM problems as reviewed by Hwang and Yoon [1981]. There were calls in early 1990s to develop new methods that could produce consistent and rational results, capable of dealing with uncertainties.

SECTION 1 DECISION THEORY

Decision theory is theory about decisions. The subject is not a very unified one. To the contrary, there are many different ways to theorize about decisions, and therefore also many different research traditions. This text attempts to reflect some of the diversity of the subject. Its emphasis lies on the less (mathematically) technical aspects of decision theory. Modern decision theory has developed since the middle of the 20th century through contributions from several academic disciplines. Although it is now clearly an academic subject of its own right, decision theory is typically pursued by researchers who identify themselves as economists, statisticians, psychologists, political and social scientists or philosophers. There is some division of labour between these disciplines. A political scientist is likely to study voting rules and other aspects of collective decision-making. A psychologist is likely to study the behaviour of individuals in decisions, and a philosopher the requirements for rationality in decisions. However, there is a large overlap, and the subject has gained from the variety of methods that researchers with different backgrounds have applied to the same or similar problems. [1]

SECTION 2 MULTI – CRITERIA DECISION MAKING

Multi-criteria decision making is a sub-discipline of operation research that explicitly considers multiple criteria in decision-making environments. Whether in our daily lives or in professional settings, there are typically multiple criteria that need to be evaluated in making decisions. Structuring complex problems well and considering multiple criteria explicitly leads to more informed and better decisions. There have been important advances in this field since the start of the modern multiple-criteria decision-making discipline. [2]

2.1 MCDM Problems

Multi-criteria decision-making problems can be examined under three main headings. These are choice, sorting and ranking problems. [2]

Choice Problems: Purpose of choice problems is to determine the best alternative or to be compared with each other that many alternatives available is to make a good choice in a difficult group. [2]

Sorting Problems: In this type of problems, alternatives are classified according to certain criteria or preferences. The main aim in here is to reunite the alternatives show similar characteristics and behavior. [2]

Ranking Problems: In ranking problems, alternatives are classified from good to bad in measurable or identifiable manner. [2]

2.2 MCDM Methods – An overview

Today, there are many techniques used in solving the current multi-criteria decision-making problems, thanks to advancing technology for the implementation of these techniques developed computer programs to solve problems trying to researchers, managers and decision-makers are quite bring great convenience. The MCDM methods used according to the types of problems are as follows ; [2]

Table 1

Classification of MCDM Method

	Choice Problems	**Sorting Problems**	**Ranking Problems**
Method	AHP	ELECTRE III	AHP Sort
Method	ANP	TOPSIS	UTADIS
Method	MAUT/UTA	PROMETHEE	ELECTRE-Tri
Method	PROMETHEE	AHP	FlowSort

2.2.1 ANALYTIC HIERARCHY PROCESS (AHP) METHOD

AHP can be described as a multi-criteria decision making and forecasting method that is used at decision hierarchy and it gives the percentage distribution of decision points in terms of factors that affect the decision. AHP is based on comparisons that are used to define the importance value of the decision points in terms of the factors that affect the decision using a predefined comparison scale. [3]

To make comparisons, we need a scale of numbers that indicates how many times more important or dominant

one element is over another element with respect to the criterion or property with respect to which they are ompared. [4]

Table 2

Evaluation Scale in AHP

Importance Levels	Value Definitions
1	Both factors have equal value.
3	1.factor is more important than the 2.factor.
5	1.factor is much more important than the 2.factor.
7	1.factor has a very strong importance when compared the 2.factor.
9	1.factor has a superior importance when compared the 2.factor.
2,4,6,8	Intermediate values

The main purpose is to determine how much the importance values (relative priority) reflect the reality. In order to consider AHP valid, matrices must be consistent. [3]

2.2.2 TOPSIS METHOD (Technique of Order Preference by Similarity to Ideal Solution)

TOPSIS is a multiple criteria method to identify solutions from a finite set of alternatives. The basic principle is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. [5]

A positive ideal solution maximizes the benefit criteria or attributes and minimizes the cost criteria or attributes, whereas a negative ideal solution maximizes the cost criteria or attributes and minimizes the benefit criteria or attributes. [6]

2.2.3 VIKOR METHOD

The VIKOR method was developed for multi-criteria optimization of complex systems. It determines the compromise ranking-list, the compromise solution, and the weight stability intervals for preference stability of the compromise solution obtained with the initial (given) weights. [7]

This method focuses on ranking and selecting from a set of alternatives, and determines compromise solution for a problem with conflicting criteria, which can help the decision makers to reach a final solution. [8]

SECTION 3 THE HOTEL SELECTION IN TOURISM SECTOR

Nowadays, with the development of the tourism sector, the expectations and demands of customers are changes. Customers have the choice of accommodation businesses have started to act more prudently. These developments have led to a rapid increase in competition in terms of accommodation establishments. In particular, the hospitality industry, offering alternative services is a sector that is experiencing the intense competition. [9]

In this study, with the help of AHP, TOPSIS and VIKOR methods, the hotel can provide the highest satisfaction to our customers, that is to determine the most suitable hotel. In this context, in Antalya, Balıkesir, Bodrum and Aydın regions five hotels operating in the basement were discussed by decision makers because the five regions are important touristic city in Turkey. It was also considered that the decision makers should have experience about these hotels which are chosen due to evaluating the criteria. Hotels under investigation were evaluated for five different criteria. These criteria are room fee, food diversity, security service, cleaning service and proximity to the sea. For identifying these criteria and their importance, there is a survey which includes over hundred people's suggestions. Especially, these people who spend their summer vacations in hotels regularly were chosen. In the following table, we can see the hotel alternatives and criteria.

Table 3

Hotel Alternatives and Criteria

	HOTEL		CRITERIA
S1	LIONA RESIDENCE BODRUM	**K1**	ROOM FEE FOR ONE NIGHT (TL)
S2	CAPRICE PALACE AYDIN	**K2**	CLEANING SERVICE
S3	SAH-INN PARADICE ANTALYA	**K3**	FOOD DIVERSITY
S4	TITANIC BEACH LARA ANTALYA	**K4**	SECURITY SERVICE
S5	SUNLIGHT HOTEL BALIKESIR	**K5**	PROXIMITY TO THE SEE (m)

3.1 Solution with AHP Method

Firstly, the decision matrix which has the five alternatives and five criterias was created and the best values were determined in the decision matrix.

Table 4

Decision Matrix and Normalized Decision Matrix

	COST	BENEFIT	BENEFIT	BENEFIT	COST	COST	BENEFIT	BENEFIT	BENEFIT	COST
	K1	**K2**	**K3**	**K4**	**K5**	**K1**	**K2**	**K3**	**K4**	**K5**
S1	**82**	6	3	5	20	1,000	0,667	0,333	0,556	0,500
S2	235	6	5	8	**10**	0,349	0,667	0,556	0,889	1,000
S3	303	**9**	**9**	**9**	50	0,271	1,000	1,000	1,000	0,200
S4	394	8	7	**9**	100	0,208	0,889	0,778	1,000	0,100
S5	136	5	4	4	300	0,603	0,556	0,444	0,444	0,033

Comparing the criterias with each other can provide more specific and accurate solution. Because of that, the five criterias were evaluated by over a hundred people and according the results comparison matrix was created and criteria weights were calculated.

The weighted matrix was created with multiplying criteria weights and normalized decision matrix and it was decided which hotel should be chosen. Consequently, it was found that the first hotel alternative is the most appropriate option that is LIONA RESIDENCE (BODRUM).

Table 5

Weighted Matrix

	K1	K2	K3	K4	K5	Average	Normalization	Nominal Value
S1	0,515	0,224	0,027	0,015	0,020	0,160	0,271	1,356
S2	0,180	0,224	0,045	0,024	0,040	0,103	0,174	0,868
S3	0,139	0,336	0,082	0,027	0,008	0,118	0,200	1,002
S4	0,107	0,299	0,064	0,027	0,004	0,100	0,169	0,847
S5	0,311	0,187	0,036	0,012	0,001	0,109	0,185	0,926
						0,591	**1,000**	**5,000**

3.2 Solution with TOPSIS Method

First of all, ideal and negative ideal alternatives should be determined in normalized matrix and then maximum matrix and minimum matrix are created with determining the difference between every value and maximum or minimum value in every column.

Table 6

Maximum and Minimum Matrix

MAXIMUM					
S1	0,000	0,112	0,055	0,012	0,020
S2	0,335	0,112	0,036	0,003	0,000
S3	0,376	0,000	0,000	0,000	0,032
S4	0,408	0,037	0,018	0,000	0,036
S5	0,205	0,149	0,045	0,015	0,038

MINIMUM					
S1	0,408	0,037	0,000	0,003	0,019
S2	0,073	0,037	0,018	0,012	0,038
S3	0,032	0,149	0,055	0,015	0,007
S4	0,000	0,112	0,036	0,015	0,003
S5	0,203	0,000	0,009	0,000	0,000

Lastly, the total values of every row are found in minimum and maximum matrix. Ratio ofow totals gives us the best solution. Here, the first alternative has the maximum rate. Because of that first alternative that is LIONA RESIDENCE (BODRUM) should be chosen according to this method.

Table 7

Ratio of Row Totals

ROW TOTAL (MAX)	ROW TOTAL (MIN)	MIN/MAX
0,198	0,467	2,353
0,487	0,178	0,367
0,408	0,258	0,632
0,499	0,166	0,332
0,453	0,213	0,469

3.3 Solution with VIKOR Method

The best and worst values are determined in the first step of VIKOR Method from decision matrix.

Table 8

The Best and Worst Values of Decision Matrix

	BEST (f_j)	WORST (fj)
K1	82	394
K2	9	5
K3	9	3
K4	9	4
K5	10	300

In second step, by substracting from best values to decision matrix values dividing by substracting from best value to worst value in decision matrix and normalization decision matrix is created by using r_{ij} variables. Also criteria weights are calculated according to criteria comparison matrix that compose of between one to ten values between criteria. Moreover, by multiplying the criteria weights and r_{ij} values weighted normalization matrix is obtained. Then in the fourth step, S_i and R_i value are calculated. These values demonstrate the average and worst group scores for alternatives. S_i value is calculated by sum of the weighted normalization matrix elements that are v_{ij} values. R_i value is maximum of the v_{ij} values.

Table 9

Weighted Normalization Matrix and S_i-R_i Values

	K1	K2	K3	K4	K5	Si (AVARAGE)	Ri (WORST GROUP)
S1	0,000	0,342	0,111	0,046	0,003	0,502	0,342
S2	0,144	0,342	0,074	0,011	0,000	0,572	0,342
S3	0,208	0,000	0,000	0,000	0,011	0,219	0,208
S4	0,294	0,114	0,037	0,000	0,025	0,470	0,294
S5	0,051	0,456	0,093	0,057	0,082	0,738	0,456

In step 5, to calculate the Q_i values firtly min Si, max Si, min Ri and max Ri values are found. Another parameter q that use to calculate Q_i values shows maximum group benefit. Then, Q_i values of each alternative are calculated by using the different q values.

Table 10

Calculation of Q_i Values

CALCULATING Q_i VALUES							
	Sİ	**Rİ**	**(q= 0)**	**(q= 0,25)**	**(q=0,5)**	**(q=0,75)**	**(q= 1)**
S1	0,502	0,342	0,540	0,541	0,542	0,543	0,544
S2	0,572	0,342	0,540	0,575	0,609	0,644	0,679
S3	0,219	0,208	0,000	0,000	0,000	0,000	0,000
S4	0,470	0,294	0,346	0,380	0,415	0,449	0,483
S5	0,738	0,456	1,000	1,000	1,000	1,000	1,000

S*	0,219
S-	0,738
R*	0,208
R-	0,456

Table 11

Ordering The Alternatives

	(q= 0)	(q= 0,25)	(q=0,5)	(q=0,75)	(q= 1)	Sİ	Rİ
S1	3	3	3	3	3	3	3
S2	3	4	4	4	4	4	3
S3	1	1	1	1	1	1	1
S4	2	2	2	2	2	2	2
S5	5	5	5	5	5	5	5

In sixth step, by aligning Si, Ri and Qi values from small to large, three ranking list is obtained. Then, to test the accuracy of the ranking, alternative with a minimum value is checked whether it meets two conditions. Condition 1 is acceptable advantage condition and condition 2 is acceptable stable condition. Their formulas are given in below table.

Table 12

Monitoring Conditions and Accuracy Test

Q (A^2)	0,346	0,380	0,415	0,449	0,483
Q (A^1)	0,000	0,000	0,000	0,000	0,000
Q (A2) - Q (A1)	0,346	0,380	0,415	0,449	0,483
DQ	0,25	0,25	0,25	0,25	0,25
CONDITION 1	**CORRECT**	**CORRECT**	**CORRECT**	**CORRECT**	**CORRECT**
CONDITION 2	**CORRECT**	**CORRECT**	**CORRECT**	**CORRECT**	**CORRECT**

RESULTS AND ASSESSMENTS

The change in customer demands are increasing due to hard competition conditions of global world and it affects hotel businesses profoundly. For the hotels to be able to stand out in the competitive environment, it is necessary for them to satisfy their customers' expectations by offering high quality services and even by making further improvements in their service design. Those hotels that adopt such styles are able to achieve customer loyalty and satisfaction through meeting and considering their expectations which in turn in brings along profitability.

In this study, three MCDM methods (AHP, TOPSIS, VIKOR) were described and used for hotel choice in tourism sector. First of all, it was considered about the important criteria which are used in hotel sector and they are identified as room free, cleaning service, food diversity, security service and proximity to the see by decision makers. Criteria weights are also necessary for importance level. They are calculated with a survey which has over hundred people. Moreover, five hotel alternatives are chosen in different places. They are LIONA RESIDENCE in Bodrum, CAPRICE PALACE in Aydın, SAH-INN PARADICE and TITANIC BEACH LARA in Antalya and SUNLIGHT HOTEL in Balıkesir.

According to AHP and TOPSIS method, LIONA RESIDENCE is found the most appropriate alternative when it is focused on the criteria weights. However, VIKOR method did not give any result for choosing the most available hotel since all alternative hotels provided on two conditions which are acceptable advantage condition and acceptable stable condition. Therefore VIKOR method is not relevant with this study that is hotel choice in tourism sector. As a result, when all methods are evaulated , the recommended alternative that is LIONA RESIDENCE in Bodrum should be chosen according to all determined criteria.

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