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EVALUATING ECOTOURISM DESTINATION USING ELECTRE AND PROMETHEE DECISION MODEL

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ABSTRACT

Ecotourism is one of the fastest growing tourism area in the world, regarding to decide criteria and choose destinations of ecotourism is very important issue. With this perspective choosing a destination is a kind of multicriteria decision technique problem. In this study, two of the popular families of the outranking methods PROMETHEE and ELECTRE are chosen and hypothetical example is constructed with 7 destinations and 11 criteria. According to the PROMETHEE method, the computation shows Destination 7 is the best alternative. However, according to the ELECTRE method Destination 3 stands as the best one and the second best alternative is Destination 7. For both methods, the worst alternative is same, which is Destination 5. In addition, this study indicates that both method results are close to each other but they are not identical.

Keywords: PROMETHEE, ELECTRE, Ecotourism, Outranking, Decision Model.

1. Introduction

Tourism is a major industry in the global economy and a vital sector in many countries. According to the United Nations World Tourism Organization (UNWTO), over the past six decades, tourism has experienced continued growth and diversification to become one of the largest and fastest growing sectors in the world. As one of the largest sectors in the world, tourism accounted for US$919 billion revenue worldwide in 2010 (WTO, 2011). Tourism can be defined as travelling for pleasure or enjoying yourself away from the place you reside. In the last few decades, tourism has grown considerably, mostly because people's lifestyles have varied. Many tourism types have been created in which ecotourism, as one of them, relates with sustainable development. The Brundtland Commission popularized the term sustainable development which was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission, 1987). Sustainable development offered a solution to the increasing impact on mass tourism that has social and ecological networks.

Crossette (1998) claims ecotourism is the rapidly expanding kind of the tourism industry. In the world, following the rise of the global environmental issues in the late 1960's and 1970's the term "Ecotourism" had been highly promoted (Higham, 2007). The majority of the literature points to the lack of a universally accepted definition and corresponding principles, and the foremost criticism impedes ecotourism as a concept. Much of the tourism literature today appreciates the importance of developing tourism 'sustainably'. Since ecotourism was initially just an idea not a discipline, many business and governments endorsed it without understanding basic principles (Barrow, 2006)

One can find lots of different ecotourism definitions in the literature. Ceballos-Lascarin constructed one of the first definition "this term refers to travelling to relatively undisturbed or uncontaminated natural areas with the specific object of studying, enjoying the scenery and its wild plants and animals (Ceballos-Lascuráin, 1987). But the main one usually preferred; Responsible travel to natural areas that conserves the environment and improves the well-being of local people (The Ecotown Society Newsletter, 1991).

This study aims solving ecotourism destination selection problem by using ELECTRE and PROMETHEE outranking methods. In the literature, there are lots of different applications and studies taking basis with both methods. For instance, the service quality of GSM operators has been assessed with ELECTRE and PROMETHEE methods by Çelik and Ustasüleyman (Çelik and Ustasüleyman, 2014). According to the results of their study, same operator was selected best in terms of the service quality. Comparison of different multicriteria evaluation methods for the Red Bluff diversion dam is studied by Rami and Garcia (Rami and Garcia, 2010). Balali et al. have developed ranking of structural systems by using the integration of ELECTRE and PROMETHEE Method (Balali, Zahraie, and Roozbahani, 2012). Cailloux and Olivier has studied about ELECTRE and PROMETHEE MCDA methods as reusable software components (Cailloux and Olivier, 2010).

1. Research Methodology

Hypothetic example has been created with 7 destinations (D_1, D_2,…, D_7) and 11 criteria (X_1, X_2, X_3,… X_{11}) to apply preference ordering methods (ELECTRE and PROMETHEE). Table 1 illustrates criteria that are mentioned as main criteria for the eco-tourism (McLaughlin, 2011).

Table 1: Criteria

Notation	Definition
X_1	Cost
X_2	Educational Opportunities
X_3	Mode of Transportation
X_4	Quality of Accommodation and Services
X_5	Physical Activities Available
X_6	Natural Beauty Landscape
X_7	Cultural Experiences
X_8	Outdoor Recreation Activities
X_9	Historical Places
X_{10}	Sense of Place
X_{11}	Connection to Nature

Table 2 illustrates the decision matrix that has been randomly constructed for both ELECTRE and PROMETHEE methods. Only cost criteria takes values between 0 and 100 and outdoor recreation activities criteria is dummy variable with two categories. The other criteria values are varying from 1 to 5.

Table 2: Decision Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
D1	90	5	5	3	2	5	2	0	3	3	4
D2	60	3	2	4	3	3	3	1	4	2	5
D3	50	4	3	4	4	4	4	1	3	2	4
D4	75	3	4	4	3	2	3	1	4	4	3
D5	50	2	1	2	1	3	2	0	2	1	1
D6	35	3	2	3	3	4	2	1	2	5	2
D7	40	4	3	3	4	4	4	1	5	3	4

It is assumed that the weights w_i of the criteria have been fixed (this is not a part of the PROMETHEE methods). Furthermore, $\sum_{i=1}^{m} w_i = 1$ and we assume that the weights of criteria is equally distributed. Since there are 11 criteria, each weight is approximately equal to 0.9.The outranking methods require specifying alternatives, criteria and use of the data of the decision table. In this study the decision is explained using the two of the popular families of the outranking methods, PROMETHEE and ELECTRE as follows:

2.1 ELECTRE Method

Elimination and choice expressing reality (The Elimination Et Choix Traduisant la REalité) methods, abbreviated as ELECTRE, belong to the outranking methods (Ishizaka & Nemery, 2013). ELECTRE method was first introduced by Benayoun et al. (Hwang & Yoon, 1981).The origins of ELECTRE methods go back to 1965 at the European consultancy company SEMA. This method uses the concept of an ‘outranking relations’. In addition, this method is more than a solution method; it is a philosophy of decision aid and it is discussed at length by Roy (1991). In ELECTRE method there are eight basic steps which are shortly described below.

Step 1: Construction of Decision Matrix ($A_{m\times n}$)

In the first step of ELECTRE method, we construct decision matrix. The rows (m) of decision matrix represents states (destinations) and columns (n) of the decision matrix represents each criteria. In other words $A_{m\times n}$ is the matrix seen in Table 2.

$$A_{m\times n} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix},$$

Step 2: Calculation of the Normalized Decision Matrix ($X_{m\times n}$)

In the second step, normalized decision matrix $X_{m\times n}$ is calculated by the help of decision matrix $A_{m\times n}$. The size of the normalized decision matrix is same with the size of the decision matrix.

$$X_{m\times n} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}$$

The normalized value x_{ij} is calculated as follows:

$$x_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}} \quad \text{for i =1, 2, …, m and j=1, 2, …, n.} \qquad (1)$$

By the help of equation (1), we construct the normalized matrix as shown in Table 3.

Table 3: Normalized Decision Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
D1	0.59	0.59	0.65	0.36	0.29	0.56	0.29	0.00	0.39	0.39	0.47
D2	0.39	0.35	0.26	0.48	0.43	0.34	0.44	0.50	0.53	0.26	0.59
D3	0.33	0.47	0.39	0.48	0.58	0.45	0.59	0.50	0.39	0.26	0.47
D4	0.49	0.35	0.52	0.48	0.43	0.23	0.44	0.50	0.53	0.52	0.36
D5	0.33	0.24	0.13	0.24	0.14	0.34	0.29	0.00	0.26	0.13	0.12
D6	0.23	0.35	0.26	0.36	0.43	0.45	0.29	0.50	0.26	0.65	0.24
D7	0.26	0.47	0.39	0.36	0.58	0.45	0.59	0.50	0.66	0.39	0.47

Step 3: Calculation of the Weighted Normalized Decision Matrix ($Y_{m\times n}$)

In the third step, weighted normalized decision matrix $Y_{m\times n}$ is calculated by the help of normalized decision matrix. The size of weighted normalized decision matrix is same with the size of normalized decision matrix and also with the decision matrix.

$$Y_{m\times n} = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1n} \\ y_{21} & y_{22} & \cdots & y_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ y_{m1} & y_{m2} & \cdots & y_{mn} \end{bmatrix}$$

The weighted normalized value is calculated as follows:

$$y_{ij} = w_j x_{ij} \quad \text{for i =1, 2, …, m and j=1, 2, …, n.} \qquad (2)$$

In other words, following equality holds.

$$Y_{m\times n} = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1n} \\ y_{21} & y_{22} & \cdots & y_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ y_{m1} & y_{m2} & \cdots & y_{mn} \end{bmatrix} = \begin{bmatrix} w_1x_{11} & w_2x_{12} & \cdots & w_nx_{1n} \\ w_1x_{21} & w_2x_{22} & \cdots & w_nx_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ w_1x_{m1} & w_2x_{m2} & \cdots & w_nx_{mn} \end{bmatrix}$$

By the help of equation (2), we construct weighted normalized decision matrix which is shown in Table 4.

Table 4: Weighted Normalized Decision Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
D1	0.05	0.05	0.06	0.03	0.03	0.05	0.03	0.00	0.04	0.04	0.04
D2	0.04	0.03	0.02	0.04	0.04	0.03	0.04	0.05	0.05	0.02	0.05
D3	0.03	0.04	0.04	0.04	0.05	0.04	0.05	0.05	0.04	0.02	0.04
D4	0.04	0.03	0.05	0.04	0.04	0.02	0.04	0.05	0.05	0.05	0.03
D5	0.03	0.02	0.01	0.02	0.01	0.03	0.03	0.00	0.02	0.01	0.01
D6	0.02	0.03	0.02	0.03	0.04	0.04	0.03	0.05	0.02	0.06	0.02
D7	0.02	0.04	0.04	0.03	0.05	0.04	0.05	0.05	0.06	0.04	0.04

Step 4: Determination of the Concordance and Discordance Sets (C, D)

By the help of weighted normalized decision matrix $Y_{m\times n}$, we can determine the concordance and discordance sets. Weighted normalized matrix data is compared for every pair and results are evaluated as the following “if-than” statement:

If alternative is better than or equal to other element of pair than the alternative is considered under concordance set and belongs to concordance set which is defined as C.

And, if this statement does not true, in other words if alternative is worse than the other element of the pair for relevant criteria, the alternative is considered under discordance set which is defined as D. In a mathematical way, we defined concordance and discordance sets with following equalities.

$$C = \{C_{kl}, k = 1,2,..,m \quad l = 1,2,...n \quad k \neq l\}, \text{ where } C_{kl} = \{j, y_{kj} \geq y_{lj}\} \text{ and j=1,…,n.} \qquad (3)$$

$$D = \{D_{kl}, k = 1,2,..,m \quad l = 1,2,...n. \quad k \neq l\}, \text{ where } D_{kl} = \{j, y_{kj} < y_{lj}\} \text{ and j=1,…,n.} \qquad (4)$$

Some of the concordance and discordance interval sets are given by;

$C_{12} = \{1,2,3,6,10\}$ and $D_{12} = \{4,5,7,8,9,11\}$

$C_{13} = \{1,2,3,6,9,10,11\}$ and $D_{13} = \{4,5,7,8\}$

$$C_{21} = \{4,5,7,8,9,11\} \text{ and } D_{21} = \{1,2,3,6,10\}$$

$$C_{23} = \{1,4,8,9,10,11\} \text{ and } D_{23} = \{2,3,5,6,7\}$$

$$C_{31} = \{1,4,5,7,8,9,11\} \text{ and } D_{31} = \{2,3,6,10\}$$

$$C_{32} = \{1,2,3,4,5,6,7,8,10\} \text{ and } D_{32} = \{9,11\}$$

Step 5: Construction of Concordance ($C_{m\times m}$) and Discordance Matrix ($D_{m\times m}$)

Concordance matrix which is defined as C is the matrix generated by adding the values of weights of concordance set elements. Because of this the number of columns and rows of this matrix is same and equal to value of m.

$$C_{m\times m} = \begin{bmatrix} - & c_{12} & c_{13} & \dots & c_{1m} \\ c_{21} & - & c_{23} & \dots & c_{2m} \\ . & & & & . \\ . & & & & . \\ . & & & & . \\ c_{m1} & c_{m2} & c_{m3} & \dots & - \end{bmatrix}, \text{ where } c_{kl} = \sum_{j\in C_{kl}} w_j \ .$$

Table 5: Concordance Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	---	0.36	0.54	0.36	0.90	0.63	0.54
C_2	0.63	---	0.45	0.81	0.90	0.72	0.27
C_3	0.63	0.81	---	0.72	0.99	0.81	0.72
C_4	0.63	0.72	0.45	---	0.81	0.72	0.36
C_5	0.27	0.18	0.09	0.18	---	0.18	0.00
C_6	0.54	0.63	0.36	0.54	0.99	---	0.45
C_7	0.72	0.81	0.90	0.72	0.99	0.81	---

Discordance matrix is the matrix prepared by dividing discordance set members values to total value of whole set and the size of discordance matrix is same with the size of concordance matrix. In other words, we can calculate members of discordance matrix with the help of equation (5).

$$d_{kl} = \frac{\max\limits_{j\in D_{kl}} \left| y_{kj} - y_{lj} \right|}{\max\limits_{j} \left| y_{kj} - y_{lj} \right|}, \text{ where } k = 1,2,..,m \quad l = 1,2,...m \text{ and } k \neq l \qquad (5)$$

$$D_{m\times m}=\begin{bmatrix} - & d_{12} & d_{13} & \dots & d_{1m} \\ d_{21} & - & d_{23} & \dots & d_{2m} \\ . & & & & . \\ . & & & & . \\ . & & & & . \\ d_{m1} & d_{m2} & d_{m3} & \dots & - \end{bmatrix}$$

Table 6: Discordance Matrix

	D_1	D_2	D_3	D_4	D_5	D_6	D_7
D_1	---	1	1	1	0.50	1	1
D_2	0.78	---	1	1	0.13	1	1
D_3	0.52	0.89	---	1	0.00	1	1
D_4	0.68	0.91	0.86	---	0.00	0.99	1
D_5	1	1	1	1	---	1	1
D_6	0.78	0.91	0.76	1	0.00	---	1
D_7	0.65	0.81	0.46	0.57	0.00	0.66	---

Step 6: Determine the Concordance Dominance and Discordance Dominance Matrix $(C^*_{\mathrm{m\times n}}, D^*_{\mathrm{m\times n}})$

Both concordance and discordance matrices have the same size $(m \times m)$. The members of concordance dominance matrix is calculated by comparing the members from the concordance matrix with value of $\underline{c}$ as calculated in equation (6).

$$\underline{c}=\frac{1}{m(m-1)}\sum_{k=1}^{m}\sum_{l=1}^{m}c_{kl} \quad (6)$$

If the members of concordance matrix is greater than value of $\underline{c}$, than the member of concordance dominance matrix is equal to 1, otherwise it is equal to 0.

$$\underline{c}=\frac{1}{7\times 6}\sum_{k=1}^{7}\sum_{l=1}^{7}c_{kl} = 0.5914 \text{ and } C^*=\begin{vmatrix} - & 0 & 0 & 0 & 1 & 1 & 0 \\ 1 & - & 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & - & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & - & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & - & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & - & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & - \end{vmatrix}.$$

The members of discordance dominance matrix is calculated by comparing the members from the discordance matrix with value of $\underline{d}$ as calculated in equation (7).

$$\underline{d}=\frac{1}{m(m-1)}\sum_{k=1}^{m}\sum_{l=1}^{m}d_{kl} \qquad (7)$$

If the members of discordance matrix is greater than value of $\underline{d}$, than the member of discordance dominance matrix is equal to 1, otherwise it is equal to 0.

$$\underline{d} = \frac{1}{7 \times 6} \sum_{k=1}^{m} \sum_{l=1}^{m} d_{kl} = 0.7794 \text{ and } D^* = \begin{vmatrix} - & 1 & 1 & 1 & 0 & 1 & 1 \\ 1 & - & 1 & 1 & 0 & 1 & 1 \\ 0 & 1 & - & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & - & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & - & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 & - & 1 \\ 0 & 1 & 0 & 0 & 0 & 1 & - \end{vmatrix}$$

Step 7: Determine the Aggregate Dominance Matrix (E)

$$E = \begin{vmatrix} - & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & - & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & - & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & - & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & - & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & - & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & - \end{vmatrix}$$

Step 8: Eliminate the less favorable alternative and rank them

From the first row of the aggregate dominance matrix (E), we can conclude that Destination 1 is better alternative than Destination 6. From the second row, we can conclude that Destination 2 is better alternative than Destination 1, 4 and 6. When we compare and consider all rows of the aggregate dominance matrix, we deduce that Destination 3 is the best and the second is Destination 7. In addition, the worst alternative is Destination 5. Also, from the aggregate dominance matrix, for some of the destinations we can not say that one destination is better than the other. For instance, from the second row we can conclude Destination 2 is better than Destination 6, and from the sixth row, vice versa. In other words, these destinations are incomparable.

2.2 PROMETHEE

The method called Preference Ranking Organisation Method for Enrichment Evaluations (PROMETHEE) was developed by Brans (1982), further extended by Brans and Vincke (1985) and Brans and Mareschal (1994-1997). In this study, the PROMETHEE method was used for ranking the Ecotourism destinations while GAIA plane was used for graphical interpretation of the PROMETHEE results.

In order to take the deviations and the scales of the criteria into account, a preference function is associated to each criteria. For this purpose, a preference function P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) is defined, representing the degree of the preference of alternative A_j over A_k for criteria C_i. We consider a degree in normalized form, so that following equalities and inequalities explanations are shown in below.

$0 \leq P_i$ ($\mathbf{A}_j$, $\mathbf{A}_k$) ≤ 1 and P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) = 0 means no preference or indifference.

P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) ≈ 0 means weak preference.

P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) ≈ 1 means strong preference, and P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) =1 means strict preference.

The PROMETHEE method has at its disposal six possible shapes of preferential functions (usual, U-shape, V-shape, level, linear and Gaussian), whereby every shape depends on two thresholds (*Q* and *P*). The indifference threshold (*Q*) represents the maximum deviation which the decision maker considers as unimportant, while the preference threshold (*P*) represents the minimum deviation which is considered to be decisive for the decision maker, where *P* is not allowed to be smaller than *Q*. The Gaussian threshold (*S*) represents a mean value between the thresholds *P* and *Q* (Brans, 1982). PROMETHEE can simultaneously deal with qualitative and quantitative criteria (Mareschal, 2013). Decision-makers can choose one of the suitable functions in the method. In this study, most of criteria are qualitative and therefore, usual and level type of functions usually are preferred and only for the cost criteria, linear function type is selected.

In most practical cases P_i ($\mathbf{A}_j$, $\mathbf{A}_k$) is function of the deviation $d = a_{ij} - a_{ik}$,

i.e. P_i ($\mathbf{A}_j$, $\mathbf{A}_k$)= $p_i(a_{ij} - a_{ik})$, where p_i is a non-decreasing function, $p_i(d)$=0 for $d \leq 0$, and $0 \leq p_i(d) \leq 1$ for $d > 0$.

A multicriteria preference index π ($\mathbf{A}_j$, $\mathbf{A}_k$) of $\mathbf{A}_j$ over $\mathbf{A}_k$ can then be defined considering all the criteria: π ($\mathbf{A}_j$,$\mathbf{A}_k$) = $\sum_{i=1}^{m} w_i P_i$ ($\mathbf{A}_j$,$\mathbf{A}_k$).

This index also takes values between 0 and 1, and represents the global intensity of preference between the couples of alternatives. In order to rank the alternatives, the following precedence (positive and negative outranking) flows are defined:

Positive outranking flow: $\phi^+ (A_j) = \frac{1}{n-1}\sum_{k=1}^{n} \pi (A_j, A_k)$.

Negative outranking flow: $\phi^- (A_j) = \frac{1}{n-1}\sum_{k=1}^{n} \pi (A_k, A_j)$.

ϕ^+ ($\mathbf{A}_j$), shows that an "A_i" alternative outranks all the other alternatives, while ϕ^- ($\mathbf{A}_j$), shows that an alternative is outranked by all the other alternatives. Therefore, in the case of the PROMETHEE I method, one obtains a partial ranking based on the positive and negative outranking flows. If the value of $\phi^{-}(\mathbf{A}_j)$ is smaller than value of $\phi^{-}(\mathbf{A}_k)$, than we can conclude that A_j is better alternative than A_k. In other words, the smaller value of $\phi^{-}(\mathbf{A}_j)$ means better the alternative. $\phi^{-}(\mathbf{A}_j)$ represents the *weakness* of $\mathbf{A}_j$, its *outranked* character.

PROMETHEE method is named as PROMETHEE 1 if partial ranking is used and named as PROMETHEE 2 if complete ranking is used.

The PROMETHEE I partial ranking

$\mathbf{A}_j$ is *preferred to* $\mathbf{A}_k$ when $\phi^{+}(\mathbf{A}_j) \geq \phi^{+}(\mathbf{A}_k)$, $\phi^{-}(\mathbf{A}_j) \leq \phi^{-}(\mathbf{A}_k)$, and at least one of the inequalities holds as a strict inequality.

$\mathbf{A}_j$ and $\mathbf{A}_k$ are *indifferent* when $\phi^{+}(\mathbf{A}_j) = \phi^{+}(\mathbf{A}_k)$ and $\phi^{-}(\mathbf{A}_j) = \phi^{-}(\mathbf{A}_k)$.

$\mathbf{A}_j$ and $\mathbf{A}_k$ are *incomparable* otherwise.

In this partial ranking some couples of alternatives are comparable, some others are not. This information can be useful in concrete applications for decision making.

The PROMETHEE II complete partial ranking

If a complete ranking of the alternatives is requested by the decision maker, avoiding any incomparabilities, the *net outranking flow* can be considered:

$$\varphi(\mathbf{A}_j) = \varphi^{+}(\mathbf{A}_j) - \varphi^{-}(\mathbf{A}_j).$$

In Table 6, it can be seen that Phi and Phi+ also Phi- values. All alternatives are now comparable, the alternative with the highest $\phi(\mathbf{A}_j)$ can be considered as best one. According to this Phi values the best location is the Destination 7 and the worst one Destination 5. Ranking seen below table.

Table 6: Phi Values

Actions	Phi	Phi+	Phi-
D7	0.1604	0.2362	0.0758
D4	0.0873	0.1971	0.1098
D3	0.0595	0.1657	0.1062
D2	0.0530	0.1463	0.0933
D6	0.0447	0.1962	0.1515
D1	0.0355	0.2424	0.2069
D5	-0.4405	0.0521	0.4925

Same results related with the Phi value can be seen below shape (This shape drawn by using PROMETHEE Visual software program).

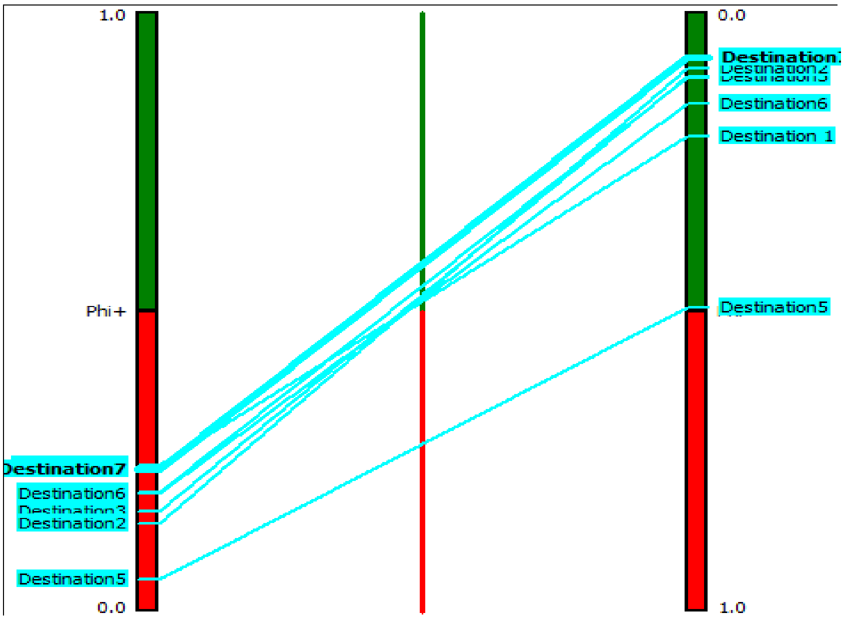

Figure 1: Phi Demonstrations

GAIA plane also provides a clear picture of a decision making problem by visualization of the PROMETHEE ranking. The GAIA visual modeling method provides the decision maker with information about the conflicting character of the criteria and the impact of the weights of the criteria on the final results. GAIA offers a visualization technique by projecting the points on a two-dimensional plane, where the plane is defined so that as few information as possible gets lost by the projection. The methodology applied in GAIA appeared earlier in statistics as a visualization tool under the name of principal components analysis (Gass and Rapcsák, 2004). In the below Figure, it can be seen that which one the best drawn with red line.

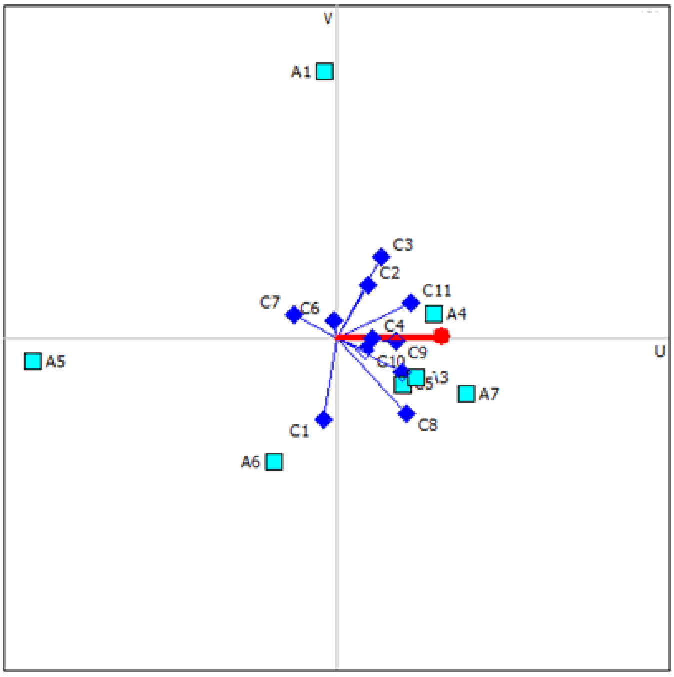

Figure 2: GAIA Plane

3. Conclusion

In this study, both PROMETHEE and ELECTRE methods have been used for the ranking Eco-tourism destinations. In the PROMETHEE method, one can reach different results according to the type of the function that chosen. In other words, it is very obvious to get different scenarios. From this perspective, it is not easy to get the identical results with the any two different methods that can be used to rank alternatives. According to PROMETHEE 2 ranking results, Destination 7 is the best and Destination 5 is the worst location. When we review the results of the ELECTRE method, they are not equal but similar. Destination 3 is the best location and second location is Destination 7. In addition, Destination 5 is the worst location for both PROMETHEE and ELECTRE methods.

Changing input parameters, criteria or weight of criteria can affect the results of the methods and also the sensitivity of ranking. For the future study, one can test sensitivity degree criteria weights, alternatives and criteria quantity

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