Chapter 3
ORESTE Method

3.1 Introduction

The ORESTE method was initially introduced by Roubens at a conference in 1980 [10–12] and then was expanded in an article in 1980. ORESTE is used when the decision maker provides an analyst with an initial ranking of the attributes for decision making. Also, the best alternative is selected among the various alternatives, which is accompanied by different qualitative and quantitative attributes. This technique is used in many cases such as ranking of Web design firms [13], material selection [14], and insurance company selection [15]. The ORESTE has the following features:

- It is one of the compensatory methods;
- Attributes should be independent;
- There is no need to convert the qualitative attributes into the quantitative attributes.

In the ORESTE method, the matrix of alternatives and attributes is initially formed based on the information received from the decision maker as in Eq. (3.1).

$$X = \begin{bmatrix} r_{11} & \cdots & r_{1j} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ r_{i1} & \cdots & r_{ij} & \cdots & r_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ r_{m1} & \cdots & r_{mj} & \cdots & r_{mn} \end{bmatrix}_{m \times n} ; \quad i = 1, \ldots, m, \; j = 1, \ldots, n \tag{3.1}$$

With respect to the matrix of Eq. (3.1), r_{ij} illustrates the element of decision matrix for ith alternative in jth attribute. In addition, the attributes are initially ranked by the decision maker.

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3.2 Description of ORESTE Method

3.2.1 The Position Matrix

In this matrix, the alternatives are ranked based on the attributes and according to the decision matrix.

3.2.2 The Block Distance

The block distance of each alternative is obtained from Eq. (3.2) [12].

$$d\left(0, A_{ij}\right) = \alpha r_{ij}(\alpha) + (1 - \alpha) r_j; \quad i = 1, \ldots, m,\ j = 1, \ldots, n \tag{3.2}$$

where α represents the succession rate, and $0 < \alpha < 1$, r_j is the prioritized values by the decision maker, and r_{ij} is the value of the position matrix of *i*th alternative in *j*th attribute.

3.2.3 The Block Distance Matrix

The block distance of each element in the position matrix is computed and placed in the block distance matrix.

3.2.4 The Final Ranking of Alternatives

The ranking technique based on the pairwise comparison of block distances is as; if $d\left(0, A_{ij}\right) \leq d\left(0, A_{i'j}\right)$, consequently, $R\left(A_{ij}\right) \leq R\left(A_{i'j}\right)$ [12]. Usually, $\frac{1}{3} \leq \alpha \leq \frac{1}{2}$ is considered. The total ranking of alternatives is derived from allocating the rank to any value of alternative attribute and aggregating all common attributes as in Eq. (3.3) [10–12].

$$R(A_i) = \sum_{j=1}^{n} R\left(A_{ij}\right); \quad i = 1, \ldots, m \tag{3.3}$$

Fig. 3.1 Decision matrix for hospital construction projects

$$\begin{array}{c} \\ \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{ccc} + & - & + \\ C_1 & C_2 & C_3 \\ \left[\begin{array}{c}\text{Very high} \\ \text{Moderate} \\ \text{Low}\end{array}\right. & \begin{array}{c}3 \\ 1.200 \\ 1.500\end{array} & \left.\begin{array}{c}\text{High} \\ \text{Moderate} \\ \text{Very high}\end{array}\right] \end{array}$$

3.3 Case Study

Three projects of A_1, A_2, and A_3 were proposed by experts for constructing a hospital. The attributes such as the suitability of the construction site (C_1), cost (C_2), and strength (C_3) are available for decision making and the decision matrix as shown in Fig. 3.1.

The decision maker expresses the order of importance of the attributes as follows:

$$C_1 > C_2 > C_3$$

The purpose is to choose the best project, and the final ranking of alternatives is expressed by the ORESTE method.

❖ **Solution**

(A) **The position matrix**

Initially, the position matrix is formed as shown in Fig. 3.2, in which alternatives are ranked based on the attributes. The negative cost attribute should be considered in this matrix formation, and the first rank belongs to the lowest value.

According to the order of the attributes expressed by the decision maker:

$$r_1 = 1, \quad r_2 = 2, \quad r_3 = 3$$

(B) **The block distance**

The block distance values are obtained from the following and where the values of $r_{ij}(\alpha)$ are obtained from the values of the position matrix, and r_j represents the values of the attributes prioritized by the decision maker. Thus, the following result is obtained as an example:

Fig. 3.2 Position matrix

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{ccc} C_1 & C_2 & C_3 \end{array} \\ \begin{bmatrix} 1 & 3 & 2 \\ 2 & 1 & 3 \\ 3 & 2 & 1 \end{bmatrix} \end{array}$$

$$d(0, A_{11}) = \alpha r_{11}(\alpha) + (1 - \alpha)r_1 = 1\alpha + (1 - \alpha) = 1$$

where $r_{11}(a)$ means the amount of position matrix of the first alternative in first attribute. Similarly, the other block distance values are obtained as follows:

$$\begin{aligned}
d(0, A_{12}) &= \alpha r_{12}(\alpha) + (1 - \alpha)r_2 = 3\alpha + 2(1 - \alpha) = 2 + \alpha \\
d(0, A_{13}) &= \alpha r_{13}(\alpha) + (1 - \alpha)r_3 = 2\alpha + 3(1 - \alpha) = 3 - \alpha \\
d(0, A_{21}) &= \alpha r_{21}(\alpha) + (1 - \alpha)r_1 = 2\alpha + (1 - \alpha) = 1 + \alpha \\
d(0, A_{22}) &= \alpha r_{22}(\alpha) + (1 - \alpha)r_2 = 1\alpha + 2(1 - \alpha) = 2 - \alpha \\
d(0, A_{23}) &= \alpha r_{23}(\alpha) + (1 - \alpha)r_3 = 3\alpha + 3(1 - \alpha) = 3 \\
d(0, A_{31}) &= \alpha r_{31}(\alpha) + (1 - \alpha)r_1 = 3\alpha + (1 - \alpha) = 1 + 2\alpha \\
d(0, A_{32}) &= \alpha r_{32}(\alpha) + (1 - \alpha)r_2 = 2\alpha + 2(1 - \alpha) = 2 \\
d(0, A_{33}) &= \alpha r_{33}(\alpha) + (1 - \alpha)r_3 = \alpha + 3(1 - \alpha) = 3 - 2\alpha
\end{aligned}$$

(C) **The block distance matrix**

Fig. 3.3 indicates the block distance matrix.

(D) **The final ranking of alternatives**

First, the pairwise comparison of the block distances is as follows:

$$\begin{array}{ccccccccc}
1 & < 1 + \alpha & < 2 - \alpha & < 1 + 2\alpha & < 2 & < 3 - 2\alpha & < 2 + \alpha & < 3 - \alpha & < 3 \\
R(A_{11}) & < R(A_{21}) & < R(A_{22}) & < R(A_{31}) & < R(A_{32}) & < R(A_{33}) & < R(A_{12}) & < R(A_{13}) & < R(A_{23}) \\
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9
\end{array}$$

The ranking of alternatives and their severity is calculated as follows:

$$\begin{aligned}
R(A_1) &= 1 + 7 + 8 = 16 \\
R(A_2) &= 2 + 3 + 9 = 14 \\
R(A_3) &= 4 + 5 + 6 = 15
\end{aligned}$$

Thus, the fist project (A_1) is the best alternative, and the final ranking is obtained as follows:

$$A_1 > A_3 > A_2$$

Fig. 3.3 Block distance matrix

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array}
\begin{array}{c} \begin{array}{ccc} C_1 & C_2 & C_3 \end{array} \\
\begin{bmatrix} 1 & 2 + \alpha & 3 - \alpha \\ 1 + \alpha & 2 - \alpha & 3 \\ 1 + 2\alpha & 2 & 3 - 2\alpha \end{bmatrix} \end{array}$$

3.4 Conclusion

The ORESTE method is another important decision-making method for selecting the best alternative used by managers, experts, and even ordinary people. In this technique, the severity of alternatives is determined using a combination of the quantitative and qualitative attributes and without the need to convert the qualitative attributes into the quantitative attributes and based on the block distance, and then, they are ranked. Further, having the short steps is another advantage of this method as shown in Fig. 3.4.

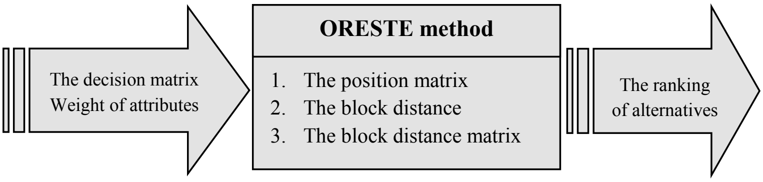

Fig. 3.4 A summary of the ORESTE method