Université Gustave Eiffel

Report about Decision Making Problem

Elaborated by : **Arous Souhir – Master 2 SIA**

Problem and objective

During this study we will have to choose the best hotel to stay in by having several alternatives and making our choice taking into account several criteria.

Alternatives : Names of hotels

Criteria : Rating Location, Rating Rooms ...

To achieve this we have several methods and this is what we will see through this report.

Data familiarization and preprocessing

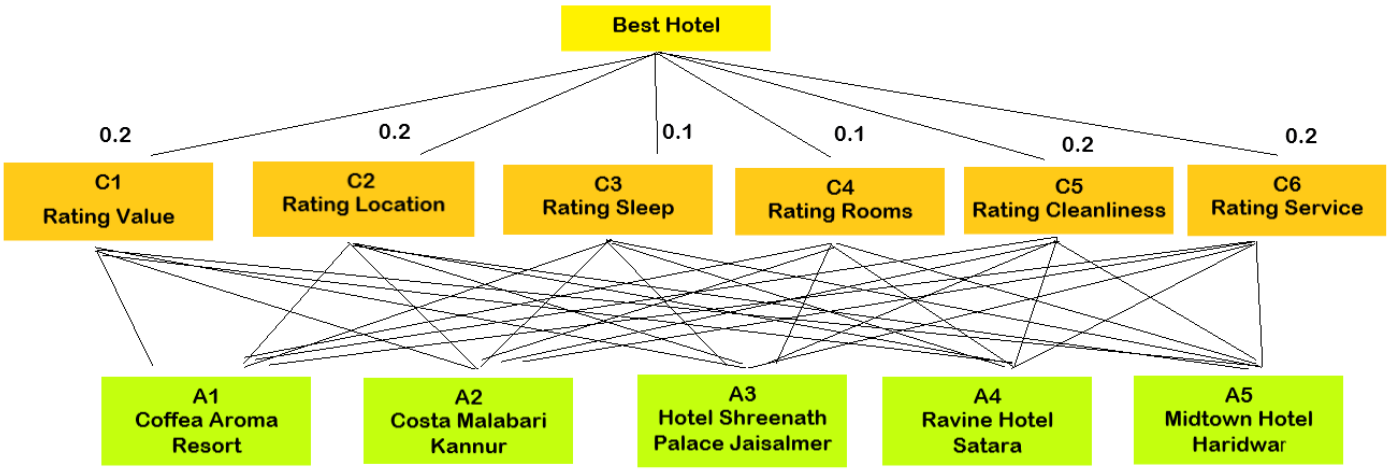
Source : https://www.kaggle.com/harikrishna9/hotel-feed-back-data

The dataset contains 7 columns (criteria) and 625 rows (alternatives).

I started by deleting all rows that contain empty cells. Then, I chose the criteria and the alternatives I'm going to work on. I chose :

6 Criteria : C1-Rating Value, C2-Rating Location, C3-Rating Sleep Quality, C4-Rating Rooms, C5-Rating Cleanliness, C6-Rating Service

5 Alternatives : A1-Coffea Aroma Resort, A2-Costa Malabari Kannur, A3-Hotel Shreenath Palace Jaisalmer, A4-Ravine Hotel Satara, A5-Midtown Hotel Haridwar.



After determining criteria weights and few calculations I got this table :

	C1-Rating Value	C2-Rating Location	C3-Rating Sleep Quality	C4-Rating Rooms	C5-Rating Cleanliness	C6-Rating Service
A1-Coffea Aroma Resort	4.266667	4.533333	4.066667	3.888889	3.911111	4.244444
A2-Costa Malabari Kannur	4.200000	4.418182	4.381818	3.909091	4.309091	4.490909
A3-Hotel Shreenath Palace Jaisalmer	4.523810	4.777778	4.095238	4.603175	4.222222	4.730159
A4-Ravine Hotel Satara	3.781250	4.691964	3.857143	3.995536	3.848214	3.549107
A5-Midtown Hotel Haridwar	3.777778	4.000000	3.500000	3.611111	3.611111	3.722222
Max	4.523810	4.777778	4.381818	4.603175	4.309091	4.730159
Min	3.777778	4.000000	3.500000	3.611111	3.611111	3.549107
Weights	0.200000	0.200000	0.100000	0.100000	0.200000	0.200000
Sum	20.549504	22.421257	19.900866	20.007801	19.901750	20.736842

Since each hotel has several Rating values, I calculated the average for each column. Moreover, It is important to note that each criterion should have its own weight so that all of them will sum up to 1. Besides, our goal is to maximize each criterion, we don't have a minimization case in our example.

Having this table as a base, we can now start discovering the methods :

Entropy

The main purpose of the Entropy method is to define the objective weight base on the entropy concept :

$$w_j = \frac{1 - E_j}{\sum_{j=1}^{n} (1 - E_j)}$$

Step 1

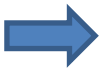
Normalization: p_ij = x_ij/sum{j}(x_ij)

Step 2

Entropy: e_j = -k * p_ij * ln(p_ij)

Step 3

w_j = 1-e_j / sum(1-e_j)



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RANK :
C6-Rating Service          0.321314
C4-Rating Rooms            0.178648
C3-Rating Sleep Quality    0.148963
C1-Rating Value            0.136527
C5-Rating Cleanliness      0.112223
C2-Rating Location         0.102325
```

WSM + WPM + WASPASS

The alternatives are compared by multiplying different ratios, one for each criterion, raised to the power of the corresponding weight.

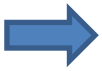
The 3 methods have the same first step which is the normalization.

Step 1

Normalization: [MAX] p_ij = x_ij/max{j}(x_ij) - [MIN] min{j}{x_ij}/x_ij

WSM (Weighted sum method)

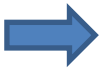
$$A_i^{\text{WSM-score}} = \sum_{j=1}^{n} w_j a_{ij}, \text{ for } i = 1, 2, 3, \ldots, m$$



```
A3-Hotel Shreenath Palace Jaisalmer    0.989428
A2-Costa Malabari Kannur               0.945437
A1-Coffea Aroma Resort                 0.916681
A4-Ravine Hotel Satara                 0.867077
A5-Midtown Hotel Haridwar              0.817770
```

WPM (Weighted product method)

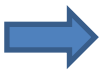
$$P(A_K/A_L) = \prod_{j=1}^{n} (a_{Kj}/a_{Lj})^{w_j}, \text{ for } K, L = 1, 2, 3, \ldots, m.$$



```
A3-Hotel Shreenath Palace Jaisalmer    0.989222
A2-Costa Malabari Kannur               0.944378
A1-Coffea Aroma Resort                 0.916141
A4-Ravine Hotel Satara                 0.863750
A5-Midtown Hotel Haridwar              0.817428
```

WASPAS (Weighted aggregated sum product assessment)

This method is a unique combination of weighted sum model (WSM) and weighted product model (WPM).



```
Q_i :
[0.98932472762392,
 0.9449077531830232,
 0.9164110523924061,
 0.8654134624313213,
 0.817598827553728]
```

TOPSIS

The basic principle of TOPSIS method is that the best alternative should have the shortest distance from the ideal solution and the farthest distance from the anti-ideal solution.

Step 1

Normalization: r_ij

$$\alpha_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{M}(a_{ij})^2}}$$

Step 2

Calculate the weighted normalized decision matrix.

$$\chi_{ij} = \alpha_{ij} * \omega_j \quad \text{with} \quad \omega_j = \frac{w_j}{\sum_{j=1}^{N} w_j}$$

Step 3

Determine the best and the worst alternative for each criterion V_j+ and V_j-

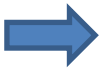
Step 4

Calculate the Euclidean distance between the target alternative and the best/worst alternative: SQR(v_ij - v_j+) and SQR(v_ij - v_j+)

Step 5

For each alternative calculate the similarity to the worst alternative. The results are our TOPSIS scores

$$s_i = \frac{d_i^w}{d_i^w + d_i^b}$$



```
A3-Hotel Shreenath Palace Jaisalmer    0.911533
A2-Costa Malabari Kannur               0.688781
A1-Coffea Aroma Resort                 0.566163
A4-Ravine Hotel Satara                 0.324761
A5-Midtown Hotel Haridwar              0.089272
```

Conclusion

Thanks to several methods which help us with decision making, we have our hotels ranking :

```
A3-Hotel Shreenath Palace Jaisalmer
A2-Costa Malabari Kannur
A1-Coffea Aroma Resort
A4-Ravine Hotel Satara
A5-Midtown Hotel Haridwar
```