How to use basic concepts of multi criteria decision making?

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ANALYTIC HIERARCHY PROCESS

The Analytic Hierarchy Process (AHP) is a general theory of measurement. It is used to derive ratio scales from both discrete and continuous paired comparisons in multilevel hierarchic structures. These comparisons may be taken from actual measurements or from a fundamental scale that reflects the relative strength of preferences and feelings. It has found its widest application in multi criteria decision making. The AHP is based on pairwise comparisons of the criteria.

Reference
GASS, S. I., HARRIS, C. M. (Eds). (2001). *Encyclopedia of Operations Research and Management Science*. 2nd Ed. Kluwer Academic Publishers, 960 pp. ISBN -07923-7827-X.

DECISION TABLE

Consider a multi criteria decision making problem with m criteria and n alternatives. Let C_1, …, C_m and A_1, .., A_n denote the criteria and alternatives, respectively. A standard feature of multi criteria decision making methodology is the decision table as shown below. In the table each row belongs to a criterion and each column describes the performance of an alternative. The element a_{ij} describes the performance of alternative A_j against criterion C_i.

$$
\begin{array}{c|ccc}
 & \mathbf{A_1} & \cdot \quad \cdot & \mathbf{A_n} \\
\hline
\mathbf{C_1} & a_{11} & \cdot \quad \cdot & a_{m1} \\
\cdot & \cdot & \cdot \quad \cdot & \cdot \\
\cdot & \cdot & \cdot \quad \cdot & \cdot \\
\mathbf{C_m} & a_{m1} & \cdot \quad \cdot & a_{mn}
\end{array}
$$

Reference
FULOP, J. (2000). *Introduction to Decision Making Methods*. pp. 3-4. Available from: https://www.academia.edu/22906650/Introduction_to_Decision_Making_Methods

MULTI CRITERIA DECISION MAKING

Multi Criteria Decision Making, also known as Multi Criteria Decision Analysis, is about making decisions when multiple criteria (or objectives) need to be considered together in order to rank or choose between alternatives.

Reference
1000minds (2023). *Multi-Criteria Decision Analysis (MCDA/MCDM). Introduction*. Available from: https://www.1000minds.com/decision-making/what-is-mcdm-mcda

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PAIRWISE COMPARISON

The criterion weight estimations are scored relative to each other by pairwise comparing them. For example, the application of the AHP method is based on the comparisons of the pairs.

Reference
1000minds (2023). *Multi-Criteria Decision Analysis (MCDA/MCDM). Scoring and weighting methods*. Available from: https://www.1000minds.com/decision-making/what-is-mcdm-mcda

SAATY MATRIX

Saaty's matrix is used in a technique of weight criterion estimations. It is also one of more used procedure in this domain. It is based on the comparisons of the pairs. We compare the weight of individual criterion with each other. The outcome is a numerical determination of the weight of individual criteria.

Question 'How important is i-th criterion relative to j-th criterion?' is used to establish the weights for the criteria. For each pair of criteria, the decision maker is required to respond to a pairwise comparison question asking the relative importance of the two. The responses can use a nine-point scale expressing the intensity of the preference for one criterion versus another. We can speak about 'Scale of Relative Importance'.

The matrix is square, positive and reflexive, and its transpose is inverse.

Reference
SAATY, T. L. (1980). *The Analytic Hierarchy Process*. New York : McGraw-Hill International Book Company. ISBN 0070543712.

SAATY SCALE OF RELATIVE IMPORTANCE

Saaty's scale of relative importance 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 compared. The nine-point scale expresses: the equal importance (the number 1) means that two activities contribute equally to the objective, …, the strong importance (the number 5) means that experience and judgement strongly favour one activity over another, …, the extreme importance (the number 9) means that the evidence favouring one activity over another is of the highest possible order of affirmation.

Reference
SAATY, T. L. (2008). Decision making with the analytic hierarchy process. *Int. J. Services Sciences*, 1(1), 83-98.