AN INTERACTIVE PROCEDURE TO DETERMINE THE ELEMENTS OF A PAIRWISE COMPARISON MATRIX

ABSTRACT

One of the findings of our previous research aimed at investigating the properties of pairwise comparison matrices (PCM) in various decision-making problems was that the elicitation process, which provides the initial data for further analysis, can influence the final result (preferences, weights). The elicitation process is crucial for getting consistent, near-consistent or inconsistent PCM. Decision support systems apply different approaches in practice. The proposed interactive method can be applied for individual decision-making problems with verbal scale. The involvement of the decision maker (DM) and some special rules can ensure that the process either provides a near-consistent and error-free PCM or demonstrates the inability of the DM to reach that goal.

Keywords: pairwise comparison matrix, elicitation methods, verbal scale, near-consistency

1. Introduction

The AHP approach consists of three key modules: a) Problem structuring and making problems definition of the hierarchy, b) Elicitation of pairwise comparisons, c) Derivation of priority vectors and their linear combinations [1]. This paper focuses on the second module and recommends an interactive method for eliciting the elements of a PCM in verbal scale in case of special types of decision-making problems.

2. Literature Review

Calculation methods in the third step need consistent or near-consistent matrices. Saaty defines a near consistent matrix [2] as a matrix that is a small reciprocal (multiplicative) perturbation of a consistent matrix. Several authors suggest algorithms to reach consistency or near-consistency. Xu and Wei [3] propose a method to modify a given comparison matrix, by which the consistency ratio value of the modified matrix is less than that of the original one. Cao et. al. [4] develop a heuristic approach that auto-generates a consistent matrix based on the original inconsistent matrix. According to Kou et al. [5] few of the currently-employed tactics are capable of simultaneously dealing with both cardinal and ordinal inconsistency issues. The proposed model is independent of the methods chosen to derive the priority vectors, and preserves most of the original information. Ishizaka and Lusti [6] help the decision-maker to build a consistent matrix or a matrix with a controlled error to reach a PCM where transitivity and reciprocity rules are respected. Bozóki et al. [7] give an algorithm where pairwise comparison matrices can be made consistent by the modification of a few elements. Bernasconi et. al. [8] deal with the scale problem from the viewpoint of measurement theory.

3. Objectives

Practitioners agree that it is important to ensure the consistency of the decision-maker, however, there is no consensus on how to define and measure inconsistency. Our research

concentrates on a special type of decision-making problems. The DM assumed to be intuitive during a pairwise comparison process in an individual choice problem to be applied to reveal her priorities. The goal is to design an algorithm ensuring a certain degree of consistency.

4. Methodology

The new phase of our empirical research focuses on the questioning procedure. The PCM is built on comparisons made by using verbal scale only, due to the nature of the problem. The decision-maker is present during the whole elicitation process and interactivity is allowed. The experimental setup is planned for controlling the inconsistency of the PCM and checking the error-free property of the process, too. The verbal scale allows the application of special rules for checking inconsistency. The key points are: connectedness, feasible triads, handling redundant information. The final goal is to construct interactive elicitation procedures which can be used in a decision support system to be developed by our research team.

5. Conclusions

Decision support systems have to include different approaches for MADM problems using the pairwise comparison method. The specifics of various types of decision-making problems need alternate ways of managing the elicitation process. The subject of the research is a narrow class of decision-making problems, where an intuitive DM gives verbal comparisons in an interactive process. The goal is to reach a near-consistent, error-free PCM.

6. Key References

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