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Approximate weighting method for multiattribute decision problems with imprecise parameters

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ABSTRACT

A multiattribute decision problem with imprecise parameters refers to one in which at least one of the parameters such as attribute weights and value scores is not represented by precise numerical values. Some well-known types of incomplete attribute weights are chosen and analyzed to find their extreme points. In doing so, we show that their coefficients matrix, by itself or by the change of variables, belongs to a class of M-matrix which enables us to find its extreme points readily due to the inverse-positive property.

The knowledge of extreme points not only helps us to prioritize alternatives but also supports iterative exploration of decision-maker's preference by investigating modified extreme points caused by additional preference information. A wide range of eligible attribute weights, however, often fail to result in the best alternative or a complete ranking of alternatives. To address this situation, we consider an approximate weighting method, so called the minimizing squared deviations from extreme points (MSD) which locates the attribute weights at the barycenter of a weight set. Accordingly, the MSD approach extends the rank order centroid (ROC) weighting method which is known to outperform other approximate weighting methods in case of ranked attribute weights. The evidence of the MSD's superiority over a linear program-based weighting method is verified via simulation analysis under different forms of incomplete attribute weights.

Keywords: Multiattribute decision analysis, Incomplete information, Extreme points, and Approximate weights.

1. Introduction