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IDEA BY MULTIPLE OBJECTIVE PROGRAMMING

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Abstract. *The purpose of this paper is to propose a multiple objective programming (MOP) for imprecise data envelopment analysis (IDEA). The proposed model has four advantages: (1) Unlike both Despotis and Smirlis's and Cooper et al.'s methods, the efficiencies generated by the proposed method can be compared directly. (2) No matter how many decision making units (DMUs) are evaluated, our proposed method can simultaneously resolve the efficiencies of all DMUs by using a multiple objective programming approach. On the contrary, the efficiency of each DMU obtained by both Despotis and Smirlis's and Cooper et al.'s methods should be generated one by one. (3) Without adapting variable alternation, model reconstruction is not necessary once the number of DMUs changes. (4) An ideal DMU highlights that the evaluation is based on the best DMU, which helps to show the improving strategy for each DMU. Two examples are employed to illustrate the merit of our approach.*

Keywords: Data envelopment analysis, Multiple objective programming, Imprecise Data, Ordinal data

1. **Introduction.** Cooper et al. developed IDEA to overcome the issues with imprecise data [1], i.e., some data is known to be within specified intervals, while other data is recognized in the form of ordinal relations [3]. Soon after, DEA papers such as developed by Cooper et al., Lee et al., Zhu and Despotis and Smirlis were to handle the imprecise data issue [4,7,13,14,5]. However, their papers were limited to measuring the efficiency of each DMU one by one. In other words, each DMU can find the best weight for itself. Therefore, all DMUs can not compare directly because of different basis. Yu et al. used multiple objective programming (MOP) to obtain the common weight and then discriminate all DMUs on the same basis [11]. However, their model needs to be reconstructed once the numbers of DMUs change.

IDEA method is to transform the non-linear model into a linear programming equivalent by imposing scale transformations on the data and variable alternations where the products of variables are replaced by new variables [5]. The weakness of the IDEA model [3] is that in general it must be reconstructed when new DMUs come into consideration or some units are removed. In order to identify a unity element and maximize each input or output data column, the scale transformations on the data is necessary in IDEA, which then is used as the basis for variable selection. The scale transformations caused reconstructing issues while the number of DMU varied. Despotis and Smirlis's method is an alternative to the Cooper et al. approach. Their method transformed the non-linear