Solving Fuzzy Slack-based Measure Model by Possibilistic Programming Approach

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Abstract

Evaluating performance is an important issue, which is participated in every operation. In the context of performance evaluation, data envelopment analysis (DEA) is a pioneer tool and in the DEA models, slack-based measure of efficiency (SBM) model is the best. Yet in fuzzy slack based measure of efficiency, there was not a method that can evaluate systems with more than one fuzzy inputs and outputs. By considering this, that estimating all activities with crisp numbers is not available in each activity therefor, there is an acute need for a method which can work on this type of data for evaluating performance of these systems. In this paper, by converting fuzzy SBM model to an linear fuzzy model and imposing possibilistic programming approach, a new method for solving fuzzy slack- based measure of efficiency has been offered.

Keywords; Data envelopment analysis, fuzzy linear programming, possibilistic programming, fuzzy SBM model.

1- Introduction

Data envelopment analysis (DEA) is a nonparametric, mathematical programming method which is introduced by Charnes (Charnes et al., 1978), for evaluating the relative efficiency of decision-making units (DMUs) with multiple outputs and multiple inputs. The original DEA models are developed by using the radial efficiency measure, where slack values are not taken into account. If a DMU with an efficiency score of one has non-zero slack value, it is categorized into the same efficiency level together with efficient DMUs in spite that it is inefficient. The slack-based measure (SBM) is introduced by Tone (Tone, 2002) to evaluate the efficiency based on the slack values. When we use the SBM to evaluate the context, we can have an appropriate stratification of the DMU performance levels. This model adopts a non-radial method of estimation, while considering the input and output slacks. Therefore, when the efficiency value of a Decision Making Unit (DMU) equals one, the DMU displays no slacks in either its input or output. This paper seeks to combine the slack-based measure of efficiency (SBM), with the fuzzy sets theory, and develops the nonradial fuzzy slack-based measure of efficiency model (Fuzzy-SBM). DEA is widely used to estimate the efficiency values of various organizations and industries, and the SBM model solves the issue presented in efficiency ranking. However, these traditional DEA models assume crisp input and output values. If these values are fuzzy numbers, the traditional DEA models cannot accurately measure the efficiency values. For this reason, scholars (Cooper et al., 1999; Despotis and Smirlis, 2000; Guo and Tanaka, 2001; Jahanshahloo et al., 2005; Kao and Liu, 2000; Chen et al., 2013) developed the Fuzzy-DEA model, which has the fuzzy measure characteristic. Fuzzy-DEA was originally proposed by Sengupta (Sengupta, 1992), in which Sengupta proposed the fuzzy goal-oriented and constraint-based technique based on Zimmermann's (Zimmermann, 1976) method.

This provided the results of fuzzy-DEA, although the technique is limited to analyzing efficiency with multiple inputs and a single output. Kao and Liu (Kao and Liu, 2000) argued that when fuzzy data exists or there is missing data, it is necessary to adopt the fuzzy measurement concept and the Extension Principle as