Evaluating Cost Efficiency in Fuzzy Environment by Using Expected Value

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Abstract

Today, one of the most fundamental issues within the field of industrial and nonindustrial activities is evaluate the costs performance of the sectors which are associated with industrial and nonindustrial activities. Data envelopment analysis (DEA) is a nonparametric method for evaluating performance. Fuzzy sets theory is a powerful tool for mentioning ambiguous situations. Traditional DEA models cannot work with fuzzy data therefor there is a need for a method which can evaluate this type of activities. Yet, in fuzzy data envelopment analysis, there isn't a powerful method which can evaluate cost efficiency in fuzzy environment. In this paper, new methods for obtaining cost efficiency measurement with data set of fuzzy numbers in various conditions (variable return to scale and constant return to scale) are considered. These consist of situations where prices are fuzzy and unknown exactly at each decision making unit (DMU). All offered methods are applied in an assessment project and results are mentioned.

Keywords; Expected value, Data envelopment analysis (DEA), Cost Efficiency, Fuzzy data.

1- Introduction

Cost efficiency (CE) evaluates the ability to produce current outputs at minimal cost. The concept of cost efficiency can be traced back to Farrell (Farrell, 1957), who originated many of the ideas underlying data envelopment analysis (DEA) (Ariff, 2008). Following Farrell's concept of CE, its estimation requires input and output quantity data as well as exact knowledge of input prices at each decision maker unit (DMU). The first, considers that prices are fixed and known at each DMU and also data set are real or crisp. In this case, the efficiency assessment can follow the approach described by Farrell (Farrell, 1957) and operationalized by Fare et al. (Fare et al. 1985). Then, they considered that prices fix for each DMU and data sets are Fuzzy numbers. The concept of decision making in fuzzy environment was firstly proposed by Bellman and Zadeh (Bellman and Zadeh, 1970). Fuzzy linear programming problem with fuzzy coefficients was proposed by Negoita (Negoita, 1970). Maleki et al. (Maleki et al., 2000) introduced a linear programming problem with fuzzy variables and proposed a method for solving it. Maleki et al. (Maleki et al., 2000) used a certain ranking function to solve fuzzy linear programming problems. He also introduced a new method for solving linear programming problems with vagueness in constraints using linear ranking function. Jahanshahloo et al. (Jahanshahloo et al., 2008) offered a two-phase method for evaluating cost efficiency, which used a ranking function to convert fuzzy coefficients to equal crisp values.

2- Preliminaries

In this paper, DEA and fuzzy sets Preliminaries are from (Bede, 2013) and (Fang and Li, 2013). In this section concept of fuzzy sets, DEA and credibility measure have been presented. We assume that the reader is familiar with linear programming concepts.

Definition 2.1: (Efficiency – Extended Pareto-Koopmans Definition): Full (100%) efficiency is attained