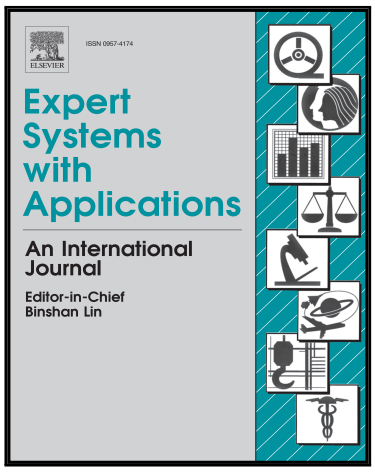

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Mohammad Amirkhan , Hosein Didehkhani ,
Kaveh Khalili-Damghani , Ashkan Hafezalkotob

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Mixed Uncertainties in Data Envelopment Analysis: A Fuzzy-Robust Approach

Mohammad Amirkhan[*, 1], Hosein Didehkhani[*, 2], Kaveh Khalili-Damghani[*, 3], Ashkan Hafezalkotob[*, 4]

[*] Department of Industrial Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran

[1] st_m_amirkhan@azad.ac.ir

[2] h.didehkhani@gmail.com

[3] kaveh.khalili@gmail.com, k_khalili@azad.ac.ir

[4] a_hafez@azad.ac.ir

Abstract

Performance measurement is one of the most essential real life decision making problems faces several criteria and different types of uncertainty and vagueness. Human expertise is mandatory for such situation although it is not enough to overcome such complicated cases. Expert systems which can sense, analyze and incorporate all details of real life decision making problems are required. In this paper an expert system is proposed in form of an uncertain Data Envelopment Analysis (DEA) approach. More formally a mixed fuzzy-robust uncertainty is addressed in the proposed DEA. Two scenario-based robust DEA models under Constant Return to Scale (CRS) and Variable Return to Scale (VRS) conditions have been proposed. Since the observed values for the inputs and outputs of Decision Making Units (DMUs) in each scenario may be ambiguous or vague, fuzzy DEA models corresponding to each of the robust scenarios are developed. So, this paper proposes four fuzzy-robust DEA models, which simultaneously maintain the advantage of each of the fuzzy and robust approaches, and at same time calculate the upper and lower bounds of the efficiency scores of DMUs under CRS and VRS conditions. Finally, to evaluate the validity and applicability of the proposed models, two numerical examples and a real case study in Small and Medium-sized Enterprises (SMEs) are presented and discussed.

***Key words*:** Data envelopment analysis; Robust optimization; Fuzzy set theory; Uncertain efficiency measurement.

1. Introduction

Evaluating the performance of organizations has always been a challenging task for managers. A widely used approach in order to evaluate the performance is to calculate the efficiency scores of organizations. Data Envelopment Analysis (DEA) is a mathematical programming approach used to calculate the efficiency of homogeneous Decision Making Units (DMUs).

One of the main challenges in using the traditional DEA approach to real-world issues is the presence of noise and uncertainty in some of the input/output data of DMUs. In other words, the