The Spherical Fuzzy Data Envelopment Analysis (SF-DEA): A Novel Approach for Efficiency Analysis

Kshitish Kumar Mohanta*, Deena Sunil Sharanappa

Department of Mathematics, Indira Gandhi National Tribal University, Lalpur, Amarkantak-484887, Annupur, Madhya Pradesh, India

*Corresponding Author

ABSTRACT

Data Envelopment Analysis (DEA) is a nonparametric, data-driven linear programming (LP) approach used to assess the relative efficiency of decision-making units (DMUs) that need several crisp inputs and outputs. But in this real world, the observed data are occasionally insufficient, confusing, ambiguous, and qualitative. This type of data can be handled using fuzzy set theory. One of the difficult tasks for the decision maker (DM) is to create fuzzy data envelopment analysis (FDEA) models for managing fuzzy input and output data. Spherical fuzzy sets have recently developed a new type of fuzzy set that allows DMs to express their level of uncertainty on spherical surfaces. In this study, the conventional DEA models are extended by using spherical fuzzy sets. The traditional Charnes-Cooper-Rhodes (CCR) and Banker-Charnes-Cooper (BCC) models are described in the context of spherical triangular fuzzy numbers (STFNs). A unique solution technique is provided to solve the proposed Spherical fuzzy CCR (SF-CCR) and Spherical fuzzy BCC (SF-BCC). This approach divides the SF-DEA model into two crisp DEA models, the first of which evaluates data value efficiency and the second of which evaluates the efficiency of the membership degree of the data value. The logarithm function is used to convert to non-linear crisp DEA model into a corresponding linear programming problem. The arithmetic mean of the efficiency scores for the data value and membership degree is used to calculate the efficiency scores of the DMUs. A numerical example is also provided to demonstrate the applicability and validity of the suggested model.

Keywords: Fuzzy Data Envelopment Analysis, SF-CCR model, SF-BCC model, Spherical Triangular Fuzzy Number.

DOI: 10.21467/abstracts.138 ISBN: 978-81-957605-2-7 (eBook)