Development of Reliable TOPSIS Method Using Intuitionistic Z-Numbers

Nik Muhammad Farhan Hakim Nik Badrul Alam[1,2] [iD],
Ku Muhammad Naim Ku Khalif[1,3(✉)] [iD], and Nor Izzati Jaini[1] [iD]

[1] Centre for Mathematical Sciences, Universiti Malaysia Pahang, Gambang, Kuantan, Pahang, Malaysia
farhanhakim@uitm.edu.my, {kunaim,ati}@ump.edu.my

[2] Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Pahang, Bandar Tun Abdul Razak Jengka, Pahang, Malaysia

[3] Centre of Excellence for Artificial Intelligence and Data Science, Universiti Malaysia Pahang, Gambang, Kuantan, Pahang, Malaysia

Abstract. Technique for order of preference by similarity to ideal solution (TOPSIS) is a multi-criteria decision-making (MCDM) method which is developed based on the distance measure from the positive and negative ideal solutions. This paper extends the TOPSIS for handling data in form of intuitionistic Z-numbers (IZN). IZN consists of restriction and reliability components which are characterized by the intuitionistic fuzzy numbers. The distance measure between IZN is proposed using the convex compound of the distances for the restriction and reliability parts. The supplier selection problem in an automobile manufacturing company is adopted to illustrate the proposed model. Sensitivity analysis is performed for the validation of the proposed model and its result shows that the proposed model gives a consistent ranking of alternatives. The strength of the proposed model is the preservation of decision information in form of IZN which does not possess the conversion into regular fuzzy number to avoid the loss of information.

Keywords: TOPSIS · Intuitionistic Z-Number · Distance Measure · Convex Compound · Sensitivity Analysis

1 Introduction

Daily life always deals with decision-making processes since majority of things human beings deal are not limited to one single choice or alternative. Making decision on the selection of choices is a tough task, especially when there are opinions from more than one person. The opinions from many people always lead to a high level of subjectivity since different people may have different thoughts and are being influenced by personal feelings.

As decision-making involves actions which are influenced by cognitive functions, it is important to develop decision-making models which mimic the human thinking process. Over the past decades, there have been a variety of decision-making models