Intuitionistic Trapezoidal Fuzzy MAGDM Problems with Sumudu Transform in Numerical Methods

John Robinson P., Bishop Heber College, Tamilnadu, India
Jeeva S, Bishop Heber College, Tamilnadu, India

ABSTRACT

Multiple attribute group decision making (MAGDM) is an important scientific, social, and economic endeavor. The ability to make consistent and correct choices is the essence of any decision process imbued with uncertainty. In situations where the information or data is in the form of an intuitionistic trapezoidal fuzzy numbers, or to construct the MAGDM problem, an intuitionistic trapezoidal fuzzy weighted averaging (ITzFWA) operator and an intuitionistic trapezoidal fuzzy hybrid aggregation (ITzFHA) operator are used. In this article, the decision maker provides the weights for aggregation in the form of an initial value problem of ordinary differential equations based on the study made on the data given by the decision maker. Decision maker weights are derived through sumudu transformation and various other numerical methods by obtaining the solution of differential equations. A numerical illustration is given to show the effectiveness and feasibility of the proposed approach.

KEYWORDS
Intuitionistic Fuzzy Number, ITzFWA and ITzFHA Operator, MAGDM, Numerical Methods, Sumudu Transform

INTRODUCTION

Decision-making is a logical human judgment process for identifying and choosing alternatives based on the values and preferences of the decision that is mostly applied in the managerial level of concerned department of any organization. Multiple Attribute Group Decision Making (MAGDM) is the process in which multiple decision makers act collectively, analyze problems, evaluate alternative courses of actions and select a solution from the available alternatives. When a group makes a decision collectively, its judgment can be powerful than that of any of its members. Through discussing, questioning, and collaborative approach, group members can identify more complete and robust solutions and recommendations. The major challenge of decision making is uncertainty and the major goal of decision analysis is to reduce uncertainty. Robust decision efforts have formally integrated uncertainty and criterion subjectivity into the decision-making process. To deal with this kind of qualitative, imprecise and incomplete information in decision problems, Zadeh (1965) suggested employing the fuzzy set theory as a modeling tool for complex systems. Intuitionistic Fuzzy Sets (IFSs) proposed by Attanassov, (1986) is a generalization of the concept of fuzzy sets. Attanassov & Gargov, (1989) expanded the IFSs, using interval value to express membership and non-membership function of IFSs. Szmid & Kacprzyk, (2002; 2003) introduced several distance functions and similarity measures for IFSs which were later used in various MAGDM problems. Many researchers have applied the IFS theory to the field of decision making. Li, (2005) presented new methods for handling

MAGDM problems are widespread in real-life decision-making situations and the problem is to find a desirable solution from a finite number of feasible alternatives assessed on multiple attributes, both quantitative and qualitative (Power, 2013). Gernstenkorn & Manko, (1991) defined a new correlation formula to measure the interrelation of intuitionistic fuzzy sets. In their definition, the correlation coefficient lies between 0 and 1, differing from the conventional range of [-1,1]. Zeng & Li, (2007) and Park et al., (2009) investigated the correlation coefficient of IFS and proposed the correlation coefficient of interval valued intuitionistic fuzzy sets. Robinson, (2016) Robinson & Amirtharaj, (2011a, 2011b, 2012a, 2012b, 2013, 2014a, 2014b, 2014c, 2015, 2016), defined correlation coefficient for different higher order intuitionistic fuzzy sets and utilized in MAGDM problems. Robinson & Jeeva, (2017), Jeeva & Robinson, (2018) proposed several methods of determining decision maker weighting vector through Jacobian and SOR iteration process and Sumudu transform which are utilized in MAGDM problems under intuitionistic fuzzy sets. Robinson & Jeeva (2016) proposed new method for Mining Trapezoidal Intuitionistic Fuzzy Correlation Rules for Eigen Valued MAGDM Problems. Recently some researches (Wang, 2008; Zhang & Liu, 2010) showed great interest in the fuzzy number IFSs and applied it to the field of decision making. Xu & Yager (2006), Xu (2007a, 2007b, 2007c, 2007d), Xu & Chen (2007), Xu (2008), Wei (2008a), developed some arithmetic aggregation operators with intuitionistic, interval valued intuitionistic fuzzy information. In many situations decision makers have imprecise/vague information about alternatives with respect to attributes. It is well known that the conventional decision making analysis using different techniques and tools has been found to be inadequate to handle uncertainty of fuzzy data. To overcome this problem, the concept of fuzzy approach (Azar, 2010) has been used in the evaluation of decision making systems. For a long period of time, efforts have been made in designing various decision making systems suitable for the arising day-to-day problems. In this aspect, an overview of type-2 fuzzy logic systems was discussed by Azar, (2012). Parameterized bilinear programming and Nonlinear programming approach to solve bi-matrix games with payoffs represented by I-fuzzy numbers were discussed by Yang et al., (2016a; 2016b).

In this work several Numerical Methods in comparison with Sumudu transform will be proposed for determining weights of decision makers and used for MAGDM problems. Differential equations are extensively used in mathematical modeling and engineering applications. In real life applications, it is too complicated to obtain the exact solution of Fuzzy Differential Equations (FDEs), where numerical methods are used to obtain the solution of FDE. With the advent of the modern high speed electronic digital computers, the numerical methods have been successfully applied to study problems.
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