Chapter 6
Multi-Criteria Decision Making in Marketing by Using Fuzzy Rough Set

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ABSTRACT

Most of the marketing problems are complex and unstructured due to the business dynamics and considerable uncertainty involved in the operating environments. Hence decision making in marketing involves evaluation of several parameters and thus multi criteria decision makings are a good choice in most of the decision-making tasks like supplier selection; market places selection; target marketing; etc. This chapter begins with a brief introduction of the theory of rough set which is an intelligent technique for handling uncertainty aspect in the data. However, the notions of fuzzy rough set and intuitionistic fuzzy rough (IFR) sets are defined, and its properties are studied. Thereafter rough set on two universal sets has been studied. In addition, intuitionistic fuzzy rough set on two universal sets has been extensively studied. Furthermore, this chapter shows that intuitionistic fuzzy rough set can be successfully practiced in decision making problems.

1. INTRODUCTION

Multi-Criterion Decision Making (MCDM) is a process in which decision makers critically evaluate each alternate according to multiple criteria. Many typical methods are proposed to solve MCDM problem in business and industry areas (Kahraman, Cebeci & Ulukan, 2003; Büyüközkan, 2004). However, most of these approaches consider the decision making with certain information of the weights and decision values, which does not make any appreciation when managing uncertain, imperfect or fuzzy knowledge. However, in our day to day life, most of the situations and associated data we come across are of not certain due to presence of uncertainties in the physical world. Uncertainty exists almost everywhere, even in the most idealized circumstances. Data set from real-life applications like marketing, medical, economics, etc. is not crisp and has uncertainties. In addition, uncertainty is an attribute of information

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and usually decision-relevant information is uncertain and imprecise. It is imperative to model these day to day problems involving uncertainties mathematically. To this end theory like probability theory, fuzzy set theory (Zadeh, 1965), intuitionistic fuzzy set (Atanasov, 1986), rough set theory (Pawlak, 1982) those deal with problems involving uncertainties are immensely useful. However each theory has their limitations. In fact, the inadequacy of the parameterization tool in these theories does not allow them to handle vagueness properly. In 1999, Molodtsov (Molodtsov, 1999) introduced the concept of soft sets and established the fundamental results of the new theory. Soft set theory somehow is free from the difficulties present in fuzzy set theory, rough set theory, probability theory, etc. In 2002, P.K. Maji (Maji & Roy, 2002) studied the theory of soft sets and exhibited some results of the soft set in decision making tasks.

In recent past, several attempts have already been made to use the rough sets theory in decision support system (Pawlak & Slowinski, 1994). The rough set approach is intended to deal with inconsistency due to which it is successfully applied to MCDA (Greco, Matarazzo & Slowinski, 2001). Finally, the output of the analysis, i.e. the model of preferences in terms of decision rules seems very convenient for decision support because it is transparent and analogous to data mining technique. The original rough set approach is not able, however, to deal with preference-ordered attribute domains and decision classes. Solving this problem was crucial for application of the rough set approach to multicriteria decision analysis (MCDA). Multi criteria fuzzy decision making has been studied by (Hong & Choi, 2000). Further multi-criteria decision making using intuitionistic fuzzy rough set is being discussed in many literatures (Das, Acharjya & Patra, 2015; Das, Mohapatro & Abburu, 2015).

This chapter begins with a brief introduction of rough set and then describes generalizations of it. This chapter endeavors to forge a connection between fuzzy set and rough set and depicts a new model fuzzy rough set and further intuitionistic fuzzy rough set to address the challenges of vagueness and impreciseness. Furthermore, we attempt to elucidate intuitionistic fuzzy rough set in two universal sets which cuts across some definitions and operations. At the end, we explain the application of intuitionistic fuzzy rough set for a marketing problem where the decision making is of multi criteria.

2. FOUNDATIONS OF ROUGH COMPUTING

At the present age of internet, a huge repository of the data is available across various domains. Therefore, it is very hard to extract useful information from voluminous data available in the universe. So, information retrieval and knowledge representation has become one of the most popular areas of recent research. Information retrieval and acquisition of knowledge is one of the important components of an information system. But, the real challenge lies in converting voluminous data into knowledge and to use this knowledge to make proper decisions. In order to transform the processed data into useful information and knowledge, there is a need of new techniques and tools. Rough set theory developed by Pawlak (1982) used to process uncertain and incomplete information is a tool to the above mentioned problem. One of its strength is the attribute dependencies, their significance among inconsistent data. At the same time, it does not need any preliminary or additional information about the data. Therefore, it classifies imprecise, uncertain or incomplete information expressed in terms of data acquired from experience.