Chapter 11
Medical Pre-Screening of Common Diseases:
An Interval-Valued Fuzzy Set Approach

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ABSTRACT

In this chapter, relation between IFS and IVFS are studied and reviewed along with some existing distance measures on IFSs. Then, some distance measures for IVFSs are derived from IFSs and some properties on distance measures for IVFSs are ascertained. In the end, an attempt has been made to perform pre-screening test for common diseases of patients in two scenarios under this setting. In the first scenario, for medical prescreening IFSs data are taken and converted into IVFSs while IVFSs data are taken into consideration for the same in the second scenario.

1. INTRODUCTION

Real world problems such as decision making, operation research, engineering problems, medical decision making or medical pre-screening etc are always tainted with uncertainty. In medical decision making, it is experienced that to prepare a set of symptoms, when medical experts question a patient regarding patient's condition, patient is not to be so confident to describe the conditions and it is also seen that they use the linguistic expression to explain their conditions which are more often vague. Medical expert needs to evaluate a list of possible symptoms for the respective diseases of the patients based on their vague linguistic expressions. However, the relations between symptoms and their corresponding diseases are not often one-to-one. The exhibition of the same disease may not be identical with different patients and even at different disease stages. Moreover, a particular symptom may signify various diseases and again in some situations in a particular patient may disarray the presumed structure of symptoms. However, knowledge base associating the symptom-disease relationship comprises of imprecision, vagueness and uncertainty in medical diagnosis process. To deal with uncertainty Zadeh (1965) developed FST. After

that various direct/indirect extensions of fuzzy set have been made and successfully applied in most of the problems of real world situation including medical diagnosis. For example, Alcantud et al., (2019) performed an analysis of survival for lung cancer resections cases with fuzzy and soft set theory in surgical decision making; a process for medical diagnosis through fuzzy decision making was studied in (Elizabeth and Sujatha, 2013). Medical diagnosis decision making based on fuzzy numbers along with compositional rule of inference were discussed in (Yao and Yao, 2001). Divergence measure for intuitionistic fuzzy sets and its application in medical diagnosis was studied in (Maheshwari, and Srivastava, 2016). A study on Bell-shaped fuzzy soft sets and their applications in medical diagnosis were presented in (Dutta and Limboo, 2017). fuzzy decision making for medical diagnosis using arithmetic of generalised parabolic fuzzy numbers was presented by (Dutta and Doley, 2019); Decision Making for Medical Diagnosis Through Credibility Theory was discussed (Dutta and Ali, 2019); medical diagnosis under uncertain environment through bipolar-valued fuzzy sets studied by (Dutta and Doley, 2020);

But in FST to each element of the universe of discourse a degree of membership between 0 and 1 is assigned. However, in some situations it is not always possible for a membership function of the type μ: X→[0,1] to precisely assign one point from [0,1], so it is more realistic to assign interval value. According to Gehrke et al. (1996) many people believe that assigning an exact number to expert's opinion is too restrictive and the assignment of an interval valued is more realistic. In such situations interval valued fuzzy set (IVFS) comes into picture. Sambuc (1975) first presented in his doctoral research (thesis) the concept of IVFS names as ϕ-fuzzy set. After development of IVFSs, different researchers have been studied this issue and applied in different areas. Some authors investigated and suggested some methods for measuring distance between IVFSs. Burillo and Bustine (1996) studied entropy and distances for IVFSs, Grzegorzewski (2004) proposed new distance measure based on Housdroff space which are straight forward generalization of Hamming distance, the Euclidean distance and their normal counter parts. Zeng and Guo (2008) studied the distances of IVFSs and relationship between entropy and similarity measure of IVFS. Park et al., (2008) proposed new distance measures for IVFS by incorporating amplitude of membership concept. Li (2009) discussed on distances of IVFS and some of its properties on metric space.

Some application using IVFSs in medical diagnosis can also be seen in literature. Chetia and Das (2010) extended Sanchez's approach for medical diagnosis using interval valued fuzzy soft sets and exhibited the technique with hypothetical case study. Ahn et al., (2011) presented a fuzzy diagnosis method based on the interval valued interview chart and the interval valued Intuitionistic fuzzy weighted arithmetic average operator and studied the occurrence information symptoms as the weights. Elizabeth and Sujatha (2014) discussed medical diagnosis based on IVFN matrices. Meenakshi and Kaliraja (2011) extended Sanchez's approach for medical diagnosis using interval valued fuzzy matrix, Mariapresenti and Arockiarani (2018) proposed a new interval valued vague weighted arithmetic average operators (IVWAA) are defined to aggregate the vague information from the symptoms. Loganathan & Pushpalatha (2018) introduced geometric mean of an interval valued fuzzy matrix and applied in agriculture field for finding the disease in plants.

On the other hand, an important generalization of FST is the theory of IFS, introduced by Atanassov (1986) ascribing a membership degree and a non-membership degree separately in such a way that sum of the two degrees must not exceed one. Application of IFSs in medical diagnosis is now a day's more interesting area of research among the researchers. De et al., (2001) studied Sanchez's approach for medical diagnosis and extended the concept with the notion of IFS. Szmidt and Kacprzyk (2001) studied medical diagnosis using their proposed distance measures. Own (2009) studied advantages

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