Chapter 1
Advanced Techniques in Predicting Student Dismissal Fuzzy Soft Sets vs. Machine Learning

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ABSTRACT

Many times in our daily routines, we face challenging decisions that require careful consideration and analysis due to their complexity and significance. Achieving the most effective solution often involves weighing multiple factors relevant to the situation. This study aims to apply a structured decision-making process by analogizing a community issue to a student scenario, illustrating a methodical approach to resolve complex problems using fuzzy soft sets. The same dataset has been applied to Machine learning models such as Random forest, Support vector machine and Naive Bayes. Out of which Random forest achieves the highest accuracy exactly

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matching the Fuzzy soft set results. Hence forth by using Fuzzy soft sets and ML based models we can predict the student dismissal rate and provide suggestions and improvements in reducing the dismissal and increasing the retention rate.

INTRODUCTION

Set theory was introduced in 1874 by German mathematician George Cantor. Set theory is the branch of mathematics concerned with the properties of well-defined collections of things (known as sets). Set theory is commonly utilized in science and math subjects such as physics, biology, and chemistry, as well as electrical engineering and computer engineering. When uncertainty came into existence, set theory is unsuitable for solving any problems, as it requires a strong understanding of logic and mathematical reasoning. In 1962, Zadeh introduced Fuzzy set theory, to overcome uncertainity and also had a number of applications (Zadeh, 1965).

The fuzzy set theory gets enhanced by its membership function,

$FY : Y \rightarrow [0, 1]$ (Eq 1)

Using the membership function we can determine to what extent an element belongs to the set. The difficulty is that how its differs in particular case. Molodtsov initiated the concept of soft theory as a different model for solving complicated problems. Soft set theory can be seen as generalization of fuzzy set theory, a soft set is a parameterized family of sets, this is named soft as the boundary of the set depends on its parameters (Molodtsov, 1999). Maji et al. in the year 2002 further investigated both fuzzy set theory and soft set theory to introduce a new theory called fuzzy soft sets. They further confirmed that soft sets can be applied for decision making.

Maji et al. (2003) investigated the relationship between fuzzy set theory and soft set theory and proposed the concept of the fuzzy soft set, which contains a subset, a superset of a soft set, equality of soft sets, and operations on soft sets such as union, intersection, AND, and OR. They also explored and analyzed the fundamental features over these operations, as well as various applications of soft set theory to decision-making (Maji, Biswas, & Roy, 2003). Pei and Maio gave an alternate definition for the subset and intersection of a soft set in 2005, improving on the work of Maji, Roy, & Biswas (2002; 2003). Chaudhuri, De & Chatterjee (2013) focused on soft relations and fuzzy soft relations, which they implemented to find a solution to several decision-making problems.

Majumdar and Samanta provided several similarity measures between soft sets and used them to tackle decision-making problems in 2008 Majumdar & Samanta, (2008), and Kharal and Ahmad (2009) defined updated definitions and uses for the

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