Chapter 5
Soft Sets and Its Applications

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ABSTRACT
Uncertainty is an inherent characteristic of modern day databases. In order to handle such databases with uncertainty, several new models have been introduced in the literature. Some new models like fuzzy sets introduced by Zadeh (1965), rough sets invented by Z. Pawlak (1982) and intuitionistic fuzzy sets extended by K.T. Atanassov (1986). All these models have their own pros and cons. However, one of the major problems with these models is the lack of sufficient number of parameters to deal with uncertainty. In order to add adequate number of parameters, soft set theory was introduced by Molodtsov in 1999. Since then the theoretical developments on soft set theory has attracted the attention of researchers. However, the practical applications of any theory are of enough importance to make use of it. In this chapter, the basic definitions of soft set, operations and properties are discussed. Also, the aim in this chapter is to discuss on the different applications of soft sets; like decision making, parameter reduction, data clustering and data dealing with incompleteness.

1. INTRODUCTION
Classical (crisp) methods of solving are efficient only for the consistent data. The data that deals with uncertainty and imprecise cannot be solvable by traditional models. In the modern day databases uncertainty is the inherent one. Soft computing solves these kinds of problems. To solve these many new models and approached have been evolved. Among the several uncertainty based models the concept of soft sets introduced by Molodtsov [Molodtsov (1999)] in 1999 is one of the latest one. Soft set is the collection of parameterized family. The models like fuzzy set which deals with membership value, rough set which works with upper and lower approximations and intuitionistic fuzzy set which is the extension of fuzzy set do not have enough parameters involved in them, which is solved by the soft set model. As explained by Molodtsov, all basic fuzzy sets are soft sets and recently Herawan claimed that all rough sets are also soft sets. So, obviously the study of sets has generated much interest in the research com-

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Soft set theory was proposed by Molodtsov [Molodtsov (1999)] in 1999. Since then there was a slow progress in research on this topic. Even though soft set have some application on various field proposed by Molodtsov. In fact the next two papers published by Maji et al in 2002 and 2003. In Maji et al in 2002 and 2003 several operations on soft sets were introduced which initiated the soft set theory among researchers and an application to decision making is also been discussed. More interestingly the basic operations on soft sets have been revised and re-revised several times with many scientists. As a result, several results established earlier have been either found to be faulty, restricted or needed to be improved. Hence the properties and applications that are proved with the improper definitions are also needs to be improved. Over the years several applications of soft sets have been proposed in almost all fields. We state about these applications detailed in the later sections. It is an established fact by now that hybrid models are superior to the individual models in speed and also in capability. So, several hybrid models involving soft sets like rough soft set, soft rough set, rough fuzzy soft, fuzzy rough soft and many other models are came into existence with its own advantages. But it is still some of them are getting modified and revised.

3. DEFINITIONS AND CONCEPTS

In this section, we shall introduce several definitions including that of soft set and operations on them are to be presented.

**Definition (Soft set):** Let $U$ is a classical set of elements, the pair $(U, E)$ is called the universe and $E$ be a set of parameters often regarded as a soft universe. Members of the universe and the parameter set are generally denoted by $x$ and $e$ respectively. A soft set over the soft universe $(U, E)$ is denoted
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