

Chapter 14

Fuzzy Optimization and Decision Making

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ABSTRACT

Selection of the best out of several strategies is always a difficult task. Fuzzy criteria allow a better approach to deal with such situations. Fuzzy optimization is one of the best tools in decision making. This chapter covers the concept of fuzziness, fuzzy sets, fuzzy membership and the features of membership functions. Also is described is the classification of fuzzy optimization. Then, decision making and various models for decision making under fuzzy environments are discussed. Standard examples of fuzzy optimization-based decision-making are included to describe the recent trends. This chapter may help researchers to explore different aspects of fuzzy optimization in decision-making.

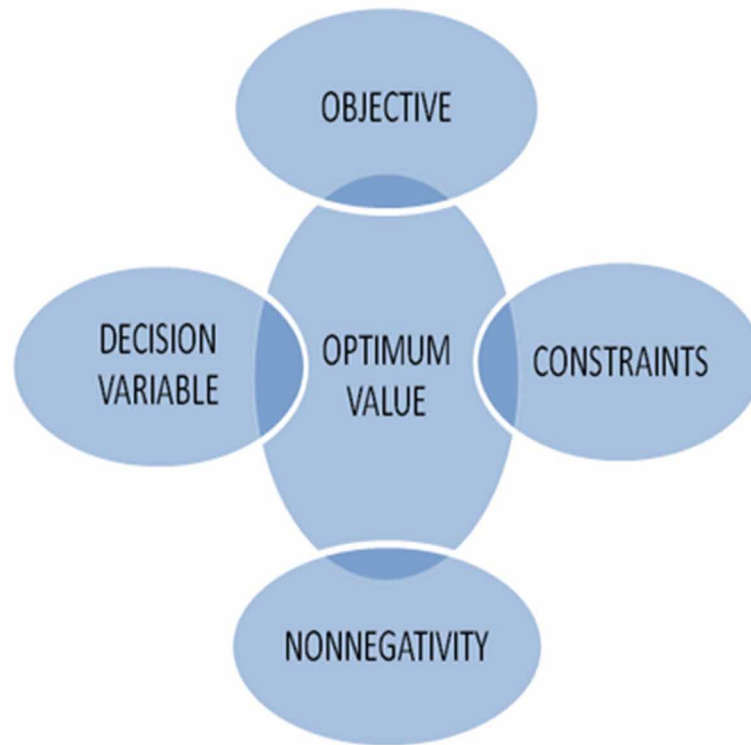
FUZZY OPTIMIZATION

To deal with a problem sometimes becomes difficult if one has more than one option to reach the solution. This is converted into optimization problems which involve objective function, basic variables, constraints and non-negativity of decision variables (Figure1). Optimization problems are often categorized in two ways; firstly, by functional area and secondly by their industrial applications. Corporate finance, investments, production, distribution, purchasing and human resources are major examples of functional area. On the other hand, airlines-trucking, oil, gas, lumber, paper-steel, agriculture, electric power and financial services are some standard examples of industrial applications.

These problems are of two types discrete and continuous depending on whether the variables are discrete or continuous. These may also involve non-precise variables which may be termed as uncertain or fuzzy. It may be quantified through probability distributions. On the other hand, if qualitative adjectives such as cold or hot, high or low, are used to describe these variables, fuzzy membership functions can be applied to enumerate these.

DOI: 10.4018/978-1-5225-5709-8.ch014

Figure 1. Optimization Cycle



In 1960's Zadeh has introduced concept of fuzzy set theory (Zadeh, 1965). It is developed later on as fuzzy optimization which involves optimization under a fuzzy environment (Ralescu, 1983; Gottwald, 1992; Lai & Hwang, 1992; Zadeh, 1996). Then after a lot of study has been done on fuzzy optimization (Lu & Fang, 2001; Tang, Wang, Fung, & Yung, 2004; Loucks, van Beek, Stedinger, Dijkman, & Villars, 2005; Ross, 2009; Mathur, Srivastava, & Paul, 2018).

Fuzziness

The concept of fuzziness can easily be understood by example that if a person exploring the meaning of a word, it may have different meaning in different circumstances. Similarly the thought of happiness may vary person to person, one may be happy with his life style but another person living in same lifestyle may not be happy. In this sense happiness becomes fuzzy for two different persons. There are several such examples like good, bad, hot, cold which may lead to fuzziness (Bisht & Jangid, 2011; Bisht, Raju, & Joshi, 2009).

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