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*To Janusz, Professor Janusz Kacprzyk, an outstanding researcher, an example to follow but, especially, a friend with whom we have shared much of our lives.*

### Abstract

The importance that decision-making problems and optimisation problems have today in all aspects of life is beyond all doubt. Despite that importance, both problems tend to be thought of as following different routes, when they have, in fact, a “symbiotic” relation. Here, we consider the different decision problems that arise when different kinds of information and framework of behaviour are considered, and we explore the corresponding optimisation problems that can be derived for searching the best possible decision. We explore the case where Fuzzy Mathematical Programming problems are obtained as well as other new ones in the fuzzy context.

**Keywords:** Decision Making, Fuzzy Sets, Fuzzy Mathematical Programming

### 1. Introduction.

Decision making is an activity that is inherent in the behaviour of people. When a decision only affects the person who decides, it may have a low impact, but when it may affect third parties (other people, a company, a market, etc.) it is essential to know in depth the mechanisms and methodologies that govern such a decision process.

In the hypothetical case that a decision-maker (a) knows all the possible consequences of their decisions, (b) knows all the alternatives, and (c) can choose rationally and knowingly, then the optimal choice will be the action whose consequence is the preferred by the decision-maker from among all the set of possible consequences that their action may have.

However, this apparently simple path is windy, complicated and sometimes almost impossible to follow due to the amount of information that needs to be collected. In simple terms, a decision maker would need to know all the alternatives, to be able to have access to all their consequences, to know how to order the results of the actions or ensure that a decision has only one consequence and so on.

Another problem arise when we assume that the context in which decision making is developed can change, the information available could be partial, etc. All of these circumstances, casuistic and options are studied in the Decision Theory area, whose first antecedent is found in [Von].

One of the most studied problems in Decision Theory considers a single decision-maker, that the information available is of a probabilistic nature, and the results of the different options that the decision-maker has (the rewards), can be ordered according to a criterion that the decision-maker establishes and which allows him/her to take the best decision among the possible ones.

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