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Sensory evaluation based on linguistic decision analysis ☆

L. Martínez

Department of Computer Science, University of Jaén, 23071 Jaén, Spain

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Abstract

The evaluation processes are widely used for quality inspection, design, marketing exploitation and other fields in industrial companies. In many of these fields the items, products, designs, etc., are evaluated according to the knowledge acquired via human senses (sight, taste, touch, smell and hearing), in such cases, we talk about *sensory evaluation*, in it an important problem arises as it is the modelling and management of uncertain knowledge in the evaluation process, because the information acquired by our senses throughout human perceptions always involves uncertainty, vagueness and imprecision.

The decision analysis techniques have been utilized in many evaluation processes, hence this paper proposes and shows the application of the *linguistic decision analysis* to sensory evaluation and its advantages, particularly based on the linguistic 2-tuple representation model, in order to model and manage consistently the uncertainty and vagueness of the information in this type of problems.

Keywords: Sensory evaluation; Decision analysis; Fuzzy linguistic approach; Linguistic variables; Linguistic 2-tuple representation model

1. Introduction

The evaluation is a process whose objective is to gather information about the evaluated product, item, service, material, etc., analyzing different aspects, indicators or criteria

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E-mail address: martin@ujaen.es

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in order to improve itself or to assess a complete description. Usually in this type of processes take part a group of individuals, called panel of experts, that provide their information about the evaluated object according to their knowledge and own perceptions. The use of decision analysis approach has been successfully applied to evaluation problems in the literature [2,8,31,35]. In decision theory before making a decision is carried out a decision analysis approach that allows people to make decisions more consistently, i.e., it helps people to deal with difficult decisions. However, decision analysis is not an idealized theory for totally rational beings nor does it describe how people actually make decisions [12]. In fact, experimental evidences from psychology shows that people generally do not process information and make decisions in ways that are consistent with the decision analysis approach. Consequently, we can see that the decision analysis although is not always followed by the decision makers it is a suitable approach for evaluation processes because it helps to analyze the alternatives, aspects, indicators of the element under study that it is the aim of the evaluation processes.

In this paper our interest is focused on *sensory evaluation* processes [17,42,45] that is an evaluation discipline whose information, provided by a panel of experts, is perceived by the human senses of *sight*, *smell*, *taste*, *touch and hearing*. The sensory evaluation is widely used in:

- *Quality inspection* of food and textile products [1,18,23,55] to determine systematically their characteristics by means of a group of experts.
- *Marketing studies* [34,39] for understanding consumers behaviors and exploiting new markets.
- *Engineering processes* [11,49] to integrate the data provided by the individuals in their design, etc.

The sensory evaluation is based on the knowledge acquired in a sensorial way by the panel of experts that take part in the evaluation process. A suitable mathematical formulation is not easy in this type of problems because human perceptions are subjective and not objective, therefore the assessments provided by the individuals are vague and uncertain. Initially classical computational techniques used in sensory evaluation were based on statistics and factorial analysis, but these methods are not efficient for solving sensory evaluation problems because uncertainties in this type of problems have a non-probabilistic character since they are related to imprecision and vagueness of meanings. In such a case, linguistic descriptors are straight direct provided by the experts to express their knowledge about the evaluated element. The fuzzy linguistic approach [53] provides a systematic way to represent linguistic variables in a natural evaluation procedure. It does not require an individual to provide a precise value at which an uncertain factor exists. So it can be used as a tool to deal with uncertainty. The use of linguistic variables implies processes of computing with words [32,33,50,54] such as their fusion, aggregation, comparison, etc. To perform these computations there exist different models: (i) the semantic model [13], (ii) the symbolic one [15], and (iii) the fuzzy 2-tuple computational model [26]. The fuzzy linguistic approach has been successfully applied to decision-making [13,52] and evaluation processes [9,10,36,37] in the literature.

The decision analysis is a suitable approach for evaluation processes included sensory evaluation and the linguistic approach has provided good results in both areas decision-making and evaluation. Thus the aim of this paper is to propose a sensory evaluation