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Narasimha Bolloju

City University of Hong Kong, isnarsi@cityu.edu.hk

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On Problems and Issues in Discovery of Multi-Aggregations of Classification Problem-Solving Knowledge from Multiple Decision Makers

[Narasimha BOLLOJU](#)

Department of Information Systems, City University of Hong Kong
HONG KONG

E-mail: isnarsi@cityu.edu.hk

Abstract

Modeling of combined classification problem-solving knowledge from a group of decision makers is associated with elicitation and aggregation difficulties. In this paper we propose an aggregation possibility, named *multi-aggregation*, for discovering classification problem-solving knowledge from multiple decision makers.

Introduction

Elicitation and aggregation of subjective problem-solving knowledge from a group of decision makers is associated with many difficulties in dealing with inconsistencies and accommodating different styles of decision makers. There are many business decision problems that require such elicitation and aggregation from a multiple decision makers. Some common examples of decision situations include insurance underwriting, securities trading, and loan approval. Automated techniques for modeling such problem-solving knowledge help in minimizing the dependency on decision makers while building decision support systems and also help in training new staff. Recent developments in the field of knowledge discovery exhibit a great potential in providing automated tools and techniques for this task. This paper presents a new aggregation possibility, named multi-aggregation, for exploiting these developments in modeling and building decision support systems for classification decision problems.

Elicitation is the process of extracting and representing subjective problem-solving knowledge from decision makers or experts. Many unstructured or semi-structured decision problems are solved by qualitative means. Decision makers apply intuition and experience in solving such problems, and they cannot always easily articulate their reasoning processes. Difficulties associated with elicitation are addressed in the field of expert systems. Automated techniques such as machine learning, neural networks, statistical techniques, case-based reasoning and other hybrid techniques can be useful in addressing some of these difficulties (e.g., Chan and Wong, 1991; Markham and Ragsdale, 1995; Mechitov *et al.*, 1995). These techniques may result in varying degrees of success depending upon the type and complexity of the underlying decision problem.

The process of elicitation from multiple decision makers gets even more difficult due to the individual styles and subjectivity. An immediate problem in such situations is the combination or aggregation of problem-solving knowledge. Many typical business environments require such combination or aggregation of decision making for many reasons such as validation, consistency verification, and training. Any technique for elicitation and aggregation of problem-solving knowledge should deal with inconsistencies, conflicts, and decision makers' subjectivity.

Approaches to Aggregation of Classification Problem-Solving Knowledge

Various approaches for aggregation can be broadly categorized into those that treat all the decisions as if they were from a single decision maker, and those that combine the decisions of multiple decision makers using some form of weights.

Some examples of aggregation techniques are:

- conceptual aggregation based on conceptual clustering and case-based learning for real-time (dynamic) decision making (Chaturvedi et al., 1993),
- geometric mean of the individual judgments to obtain the combined group judgment in overcoming difficulties experienced from a lack of group consensus arising from intuitive judgments using Analytic Hierarchy Process (Davies, 1994),
- a flexible modeling approach based on Bayesian analysis for aggregation of point estimates (Clemen and Winkler, 1993),
- aggregation of preference patterns using social choice framework (Dubois and Koning, 1994)

Comparative studies on group preference aggregation are reported by Ramanathan and Ganesh (1994) and Perez and Barba-Romero (1995).

Aggregation Possibilities and Complexities

Aggregation of the problem-solving knowledge from multiple decision makers can be performed by:

1. treating all the decision makers as one individual by combining all the decisions and then discover the underlying problem-solving knowledge, or
2. using weighted combinations of preferences for aggregations (e.g., geometric mean), or
3. discovering multi-aggregations (multiple aggregations) of problem-solving knowledge and discovering decision maker groups.

The first aggregation possibility does not consider the differences in the decision making styles at all, and the second possibility results in decisions as if some form of voting has been made. The third aggregation possibility, proposed in this paper, has the potential to produce different aggregations based on decision maker style which are also discovered. This approach aims to identifying groups, rather than combining, of decision makers using similar styles of decision making in addition to discovery of the problem-solving knowledge.

Further Work

In order to achieve this multi-aggregation through automated discovery of decision models, further research is needed to answer the following questions:

1. Is it possible to discover, with a reasonable efficiency, multi-aggregations using sets of classification decisions made by multiple decision makers?
2. If it is possible then what strategy should be used for the discovery process? Should it start with combining all the decisions as if they were from a single decision maker and then proceed to identify differences to form multi-aggregations? Or, should it start the discovery using individual sets of decisions and combine the discovered knowledge to form multi-aggregations?
3. What types of measures (e.g., accuracy, deviations, agreement, similarity) should be used for evaluating the effectiveness of different multi-aggregation strategies or techniques?

Research into these aspects has potential for extending the utility of knowledge discovery techniques well beyond the realm of decision support to the discovery of decision models and a better understanding of decision making approaches.

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