Chapter 9
Methods of Group Decisions and Aggregation of Experts’ Opinions

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ABSTRACT
Expert evaluation is often the most reliable way to predict results of a certain process. Estimates from several experts are usually needed in order to achieve correct decision making. This chapter presents and systematically sorts methods for aggregation expert opinions with respect to specific features of the decision making process. Based on information theory, the chapter introduces concepts for understanding expert consensus and also discusses the impact of suppressing/emphasizing extreme estimates or of unequally valuing individual estimates. This chapter addresses the estimation of YES/NO binary results as well as numeric values of a certain attribute and also considers cases when only an estimate or a dispersion of opinions of experts is considered.

INTRODUCTION
In many practical situations, in business and industry, most managerial decision-making problems require a collaborative scheme of decision-making, in which the final decision should rest on the opinions of several experts. This is for instance the case, when we have to predict whether some event will happen or not (e.g. predicting the sale of a newly launched commercial product), or when we must estimate attributes and parameters of a given entity or event, with respect to several decision-making criteria (e.g., assessing an industrial technology with respect to several decision criteria). In the first case, we have to predict a logical value (i.e., binary or YES-or-NO decisions), whereas in the second case, we have to predict a numerical value. Typically, group

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decision-making (GDM) problems are too significant for any single individual to handle. The reliance on group experts’ decision is considered a very efficient solution especially in the case of ill-structured and vague decision-making situations. In ill-structured decision situations, it is often difficult to evaluate the correct decision solution beforehand. In such situations, usually not all the relevant variables are known. Secondly, some of the known variables are usually stochastic, vague, and qualitative in nature. In addition, in many decision-making situations, in treating a variety of business, economic, and agricultural decision problems, the problem usually involves several decision assessment dimensions, aspects, or viewpoints. Consequently, multiple, different and specific expertise is often needed in making the decisions. This is why this decision-making environment necessitates the reliance on multiple experts’ opinions, in order to enhance the quality of the decision solution obtained. However, most real world GDM takes place in ambiguous decision situations, in which the value of inputs as well as pertinent data and the sequences of the possible actions are vague or not precisely known. Therefore, it is very important to manipulate fuzzy values and concepts of evaluation in order to approximate the vague elements of the decision-making environment and also in order to comprehensively take into account all relevant effects the decision-making solution.

Actually, the most critical issue in the process of experts’ GDM is the ability to aggregate or combine these experts’ opinions, which may be in a different format or on different judgment scales. The aggregation method should handle all possible cases or situations of experts’ judgments, either in the form of binary decisions, or in the form of numerical or linguistic values that commonly arise when attributes are evaluated using multiple criteria. The experts’ opinion aggregation or combination methods can be in the form of simple formulas for computing the finally consolidated output of experts’ judgments, or in the form of a logical algorithm or procedure for reaching a consensus also leading to a final group decision output. In all cases, these final group opinions must be of a sufficient degree of exactness and free of vagueness.

This chapter presents and systematically categorizes methods of how to aggregate expert opinions with respect to various specifics and objectives of a requestor. Based on information theory this chapter introduces a concept of experts’ consensus and discusses the influence of emphasizing consensus or, alternatively, emphasizing the extreme opinions of experts for selection of a method for aggregation of estimates. The chapter also takes into account cases when opinions of experts have different values or weights. The text of this chapter differentiates between situations, when the estimated result is a binary one YES/NO or a numerical value of some attribute. Furthermore, the chapter distinguishes between cases when the requestor is only interested in an estimate itself or when he is also interested in the dispersion of opinions of individual experts.

The evaluation of group decisions and experts’ opinions is a broad topic. The objective of this chapter is to show one way to approach this topic in a systematic way and with a precise foundation. It requires the use of some formal mathematical methods, which cannot be fully avoided. The authors have tried to minimize the requirements of previous knowledge of readers from a modern mathematical instruments domain. An explanation of such concepts, as may not be entirely usual, is graphically marked by indented text.

In the next section, the prominent literature on GDM is categorized and reviewed, and the modern research trends in the field are highlighted.

BACKGROUND

Due to the significance and polymorphism or diversity of multi-expert or group decision-making problems, extensive research has been conducted