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# Expertise-based ranking of experts: An assessment level approach

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## Abstract

The quality of a formal decision is influenced by the level of expertise of the decision makers (DMs). The composition of a team of DMs can change when new members join or old members leave, based on their ranking. In order to improve the quality of decisions, this ranking should be based on their demonstrated expertise. This paper proposes using the experts' expertise levels, in terms of 'the ability to differentiate consistently', to determine their ranking, according to the level at which they assess alternatives. The expertise level is expressed using the CWS-Index (Cochran–Weiss–Shanteau), a ratio between Discrimination and Inconsistency. The experts give their evaluations using pairwise comparisons of Fuzzy Preference Relations with an Additive Consistency property. This property can be used to generate estimators, and replaces the repetition needed to obtain the CWS-Index. Finally, a numerical example is discussed to illustrate the model for producing expertise-based ranking of experts.

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*Keywords:* Ranking; Expertise; Fuzzy Preference Relations; Additive Consistency; Assessment level

## 1. Introduction

The quality of a formal decision is heavily influenced by the level of expertise of the decision maker (DM) [1]. It is presumed that a decision made by an expert is better than a decision made by a non-expert, because an expert has the ability to think differently [1–3] and the inherent ability to understand the problem in more detail and depth, so that an expert can distinguish various aspects of the situation that are usually overlooked by a non-expert [4].

When a decision is made by several decision makers (DMs), this group of experts may be responsible for making an assessment of alternatives. The group decision or group opinion is a result of the integration of the individual opinions by a mathematical aggregation [5]. One important factor that should be considered in the aggregation process is which DMs' opinions should be included in the aggregation process. This means that the composition of the DM teams can be changed, i.e. new members can join a DM team while others leave depend on their ranking [6]. To improve the decision quality, this ranking should be determined on the basis of the DM's level of expertise.

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The DM's level of expertise needs to be defined. Weiss and Shanteau [7] proposed the concept of 'the ability to differentiate consistently' to assess the expertise level, and they based this solely on the expert's level of assessing alternatives. They defined experts as those who are capable of distinguishing between cases that are similar but not exactly the same and of repeating their judgments consistently. They proposed the CWS-Index (the Cochran–Weiss–Shanteau Index), which is the ratio between discrimination and inconsistency, to assess someone's level of expertise [7,8]. The CWS-Indexes for the experts yields their ranking; the higher the CWS-Index, the higher is the DM's ranking. However, measuring inconsistency requires repetition, and accordingly the experts need to make judgments more than once. This repeated evaluation is difficult to do independently in a way that ensures that there is no influence from the previous evaluation [9]. Moreover, those whose second evaluation is similar to their first will be considered consistent, even though the first evaluation is not necessarily true [1].

In Group Decision Making research, the pairwise comparisons approach of Fuzzy Preference Relations (FPR) has the Additive Consistency (AC) property. Pairwise comparisons have the advantage of focusing the assessment on two objects at a time [10]. The AC property of FPR can be used to measure the expert's consistency level [11–16] and produces a *consistency-based experts' ranking* without considering the ability of the expert to differentiate between similar, but not identical, cases. In relation to the concept of expertise, defined as the ability to differentiate consistently, as proposed by Weiss and Shanteau [7], the methodology of determining ranking in these prior studies is not based on expertise as a whole, because the studies only consider consistency and ignore the ability to differentiate.

There have been studies to determine the ranking of experts based on their level of assessment. Among the methods used are the use of factor scores to rank the assessment result of DMs in the group decision [17], the measurement of the total deviation between the estimated value and the real value for each element of the decision matrix [18], and the measurement of the total variance of the estimated value to the actual value for each element of the decision matrix [19]. In these previous researches, the experts' ranking are determined only by the consistency of their assessments, without considering their ability to differentiate, so these studies have not used the comprehensive concept of expertise.

In this paper, we focus on a Group Decision with one criterion where the DMs are ranked based on their level of expertise, irrespective of their position in the organization. The concepts used are the combination of expertise as 'the ability to differentiate consistently' and the AC property of FPR. The experts will give their judgments in FPR, so that the repetition required in Weiss and Shanteau's methodology is replaced by an estimation using the AC property. The focus of this research is to determine the ranking of the DMs. This ranking can be used to determine which DMs' opinions should be included in the aggregation process. This ranking can also be used to determine the importance weight of the DMs and research obtaining the DMs' importance weight from their ranking has been discussed in another paper [20].

The next section of this paper discusses the concept of *expertise* and the AC property of FPR. Then a methodology to obtain an *expertise-based ranking of experts* is discussed, followed by the implementation of the proposed methodology using numerical examples. Finally, the conclusions are presented and further research associated with the development of a model of the expertise-based ranking of experts is proposed.

## 2. Expert's expertise level and FPR's additive consistency

This part discusses the previous methods used to identify the expertise level of experts, and FPR's AC property. These two methods will be combined to develop the proposed method called *expertise-based ranking of experts*.

### 2.1. Expert's expertise level

An expert is an individual who has a background in a certain area and receives recognition from his/her peers in a particular technical field [21]. If a distinction is made according to the tasks to be accomplished, there are four types of experts [7], namely: expert predictors, expert instructors, expert performers and expert judges. An expert predictor conducts an evaluation to create a scenario for the future. An expert instructor must have the ability to judge and communicate clearly to others, in the way that a football coach does to his players. An expert performer should be able to perform the task well: for instance, an expert football player can score a goal. An expert judge makes both a qualitative and a quantitative evaluation. Weiss and Shanteau [22] stated that all type of expertise are influenced by the expert's judgment, then all type of expertise can't be separated from their judgment quality and in this study, an expert means someone with expert judgment.

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