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Bonferroni Prioritized Aggregation Operators Applied to Government Transparency

Luis A. Perez-Arellano [1], Fabio Blanco-Mesa [2], Ernesto Leon-Castro [3,*] and Victor Alfaro-Garcia [4]

[1] Universidad Autonoma de Occidente, Blvd. Lola Beltrán s/n esq. Circuito Vial, Culiacán 80200, Mexico; luis.pereza@uadeo.mx
[2] Facultad de Ciencias Económicas y Administrativas, Escuela de Administración de Empresas, Universidad Pedagógica y Tecnológica de Colombia, Tunja 150001, Colombia; fabio.blanco01@uptc.edu.co
[3] Faculty of Economics and Administrative Sciences, Universidad Católica de la Santísima Concepción, Concepción 4030000, Chile
[4] Facultad de Contaduría y Ciencias Administrativas, Universidad Michoacana de San Nicolas de Hidalgo, Gral. Francisco J. Múgica S/N, C.U., 58030 Morelia, Mexico; victor.alfaro@umich.mx
* Correspondence: eleon@ucsc.cl

Abstract: This article applies the Bonferroni prioritized induced heavy ordered weighted average (OWA) to analyze a series of data and focuses on the Bonferroni average and heavy induced prioritized aggregation operators. The objective of the present work is to present a new aggregation operator that combines the heavy induced prioritized Bonferroni and its formulations and represents the Bonferroni mean with variables that induce an order with vectors that are greater than one. This work develops some extensions using prioritization. The main advantage is that different types of information provided by a group of decision makers to compare real situations are included in this formulation. Finally, an example using the operators to calculate the transparency of the websites of the 32 states of Mexico was performed. The main idea was to visualize how the ranking can change depending on the importance of the five components of the methodology. The main results show that it is possible to detect some important changes depending on the operator and the experts considered.

Keywords: Bonferroni means; prioritized aggregation operators; induced aggregation operators; OWA operator; transparency

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1. Introduction

The Organization for Economic Co-operation and Development (OECD) has recently recognized open government initiatives as critical drivers of citizens' trust and key aspects of the modernization, anticorruption, civic freedom, innovation, financial management and human resource management of the public sector of a country [1]. Moreover, a culture of transparency, participation and accountability that conforms to open government yields opportunities for economic growth, as it promotes the creation of businesses, jobs and cost-effective public policies [2]. Nonetheless, the design, creation and implementation of effective open government strategies pose a series of challenges for countries, including their alignment with national plans, strategic visions, public governance and technological resources [3–5].

Transparency and access to information are key issues for the establishment of open governments. Governmental transparency is the ability to determine what is happening inside the government [6]. Moreover, transparency fosters the accountability of actions and offers information to citizens regarding governmental decisions [7], thereby dissuading corruption and promoting efficiency, democracy and legitimacy [8]. In this sense, in-

formation is an asset, and while some administrations may use it as a trigger for best practices, others may have a radically different opinion based on their own political, administrative, institutional and demographic contexts [9,10]. These variations based on country contexts constitute the difference between freedom of information laws, their design and operations and the challenges they have for their nations, e.g., Canada and the United Kingdom or the open government of the People's Republic of China [11].

In Mexico, access to information is a citizen's right composed of three elements: normative design, institutional design, and procedures for access to public information and transparency obligations [12]. The National Institute of Transparency (INAI) is a specialized public institution that regulates transparency at the national level, including access to information, personal data protection and the development of methodologies to assess transparency [13]. Additionally, the ranking of transparency websites is measured through five components: institutional arrangements, open data, vertical collaboration, horizontal collaboration, and interface [14]. The main difficulties with this formula are that it takes an average of the results that depend on the state; some of the components are more important than others. Because the calculation is made with the same weights for each subindex for all the states, there is no real evaluation of transparency depending on the specific characteristics and problems of each state.

Recent developments in information technologies have opened the path for assessing decision-making in systemic environments. Expert and intelligent systems have proven effective in subjective, uncertain and highly complex scenarios [15,16]. In this context, to address some of the abovementioned challenges, a combination of several intelligent systems such as the Bonferroni means [17] and the ordered weighted averaging (OWA) operator [18] will be used. A special focus will be placed on the following extensions: (a) the Bonferroni ordered weighted averaging (BON-OWA) operator [19] allows adding information and making multiple comparisons between input arguments and capturing their interrelation to present information, (b) the induced ordered weighted averaging (IOWA) operator [20,21] uses induced variables in the reordering step instead of the traditional reordering based on the value of the arguments of the OWA operator, (c) the prioritized ordered weighted averaging (PrOWA) operator [22] introduces a mechanism for assigning specific weights to the participants in a group decision-making problem, and, finally, (d) the heavy ordered weighted averaging (HOWA) operator [23] features a nonbounded weighting vector that allows the over- or underestimation of results according to the expectation and knowledge of the decision maker.

According to Blanco-Mesa, León-Castro and Merigó [24], aggregation operators allow joining different pieces of information provided by several sources [25], ensuring the inclusion of all the fusion information [26,27] and combining several values into a single value [15,28]. Since the proposal of the BON-OWA operator, several new methodological contributions have been made, among which those developed by Blanco-Mesa, such as (1) the Bonferroni means with distance measures applied to entrepreneurship and human resource management [29,30], (2) the Bonferroni induced operator and heavy operator applied to enterprise risk management and sale forecasting [31,32], (3) the Bonferroni OWA variance used in strategic analysis in enterprise risk management [33], and (4) the Bonferroni covariance OWA used in research and development investment problems [34], stand out as addressing decision-making problems in business management. Recently, a paper has been published that proposed measuring transparency with another aggregation method called the prioritized induced ordered weighted average weighted average (PIOWAWA) operator. This operator considers the degree of importance, reordering and weight factors given to the information in the same formulation by the decision maker and is assessed using a Colombian transparency case [35]. Additionally, formulations have become widespread, and extensions have been proposed with other operators, such as the induced OWA operator (IOWA) [20,21], the heavy OWA operator (HOWA) [23], the OWAWA operator [36] and immediate weights (IWs) [37].