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J. Benítez, S. Carpitella, A. Certa, A.E. Ilaya-Ayza, J. Izquierdo

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Consistent clustering of entries in large pairwise comparison matrices

J. Benítez[*], S. Carpitella[†], A. Certa[‡], A.E. Ilaya-Ayza[§], J. Izquierdo[¶]

Abstract

In multi-attribute decision making the number of decision elements under consideration may be huge, especially for complex, real-world problems. Typically these elements are clustered and then the clusters organized hierarchically to reduce the number of elements to be simultaneously handled. These decomposition methodologies are intended to bring the problem within the cognitive ability of decision makers. However, such methodologies have disadvantages, and it may happen that such *a priori* clustering is not clear, and/or the problem has previously been addressed without any grouping action. This is the situation for the case study we address, in which a panel of experts gives opinions about the operation of 15 previously established district metered areas in a real water distribution system. Large pairwise comparison matrices may also be found when building comparisons of elements using large bodies of information. In this paper, we address a consistent compression of an AHP comparison matrix that collapses the judgments corresponding to a given number of compared elements. As a result, an *a posteriori* clustering of various elements becomes possible. In our case study, such a clustering offers several added benefits, including the identification of hidden or unknown criteria to cluster the considered elements of the problem.

Keywords: pairwise comparison; AHP; Miller's magic number seven; water distribution system (WDS); management and operation of a WDS; decision-making.

1 Introduction

Various decision-making techniques rely on pairwise comparisons (PCs). Traditionally, PCs are provided by experts. Due to human cognitive limitations, and the number of compared elements, the size of pairwise comparison matrices (PCMs) must be small. However, in the current information era, the information collected from databases and the internet is also susceptible to being handled as pairwise comparisons – and these collections can be huge (see [1, 2, 3], among others). In general, in highly complex problems, the number of elements to be

[*]Instituto de Matemática Multidisciplinar, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, Spain. e-mail: jbenitez@mat.upv.es

[†]FluIng, Instituto de Matemática Multidisciplinar, Universidat Politècnica de València Dipartamento dell'Innovazione Industriale e Digitale (DIID), Ingegneria Chimica, Gestionale, Informatica, Meccanica Piazza Marina, 61, 90133 Palermo (PA), Sicilia, Italy

[‡]Dipartamento dell'Innovazione Industriale e Digitale (DIID), Ingegneria Chimica, Gestionale, Informatica, Meccanica Piazza Marina, 61, 90133 Palermo (PA), Sicilia, Italy

[§]Facultad Nacional de Ingeniería, Universidad Técnica de Oruro, Ciudad Universitaria s/n, Oruro, Bolivia

[¶]FluIng, Instituto de Matemática Multidisciplinar, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, Spain