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EDITORIAL

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Special issue on multiple criteria sorting methods

Recent years have seen a flourishing interest in *multiple criteria sorting models*, that is, models for assigning alternatives to predefined ordered categories while respecting the preference order on the criteria scales.

A call for papers on this topic was issued at the International Conference on Multiple Criteria Decision Making MCDM2019, held in Istanbul, Turkey, June 16–21, 2019, but submissions were not restricted to papers presented during this conference. The papers in the present special issue are a selection of the submissions. By chance, it happens that they illustrate diversified aspects of the issues raised by this topic.

We shall start with a terminological interrogation. After all, is the term "sorting" really appropriate? In this issue, Colorni and Tsoukiàs (2021) argue that the term "rating" would be more adequate and would favour recognition by the large community of researchers who elaborate rating methods and users who apply them. Although we still use the word "sorting" in this editorial, we largely concur with Colorni and Tsoukiàs (2021).

Sorting methods and their applications has been a very active research field in the last decades. A good, yet old, survey is due to Zopounidis and Doumpos (2002). It positions multiple criteria sorting w.r.t. classification and mainly reviews models based on additive value (utility) functions and those based on outranking relations (mainly Electre-Tri models). Besides these models and their variants, almost all other major (and minor) models used in multiple criteria decision analysis have been declined or adapted to apply to sorting problems. Here are a few examples: FlowSort based on Promethee (Nemery & Lamboray, 2008), AHPSort (Ishizaka et al., 2012), sorting based on TOPSIS (de Lima Silva & de Almeida Filho, 2020), VIKORSORT (Demir et al., 2018).

Another survey by Erişkin (2021) has just been published in the present journal. It reverts to the positioning of multiple criteria sorting methods w.r.t. classification, a field that has experienced a huge development in the last decades in connection with the boom of machine learning and data analysis. The author rightly writes: "Both Multiple Criteria Decision Aid and Statistical Learning fields offer methodologies to represent the preference of the decision maker facing the sorting problem, however, there are differences in terminology, objective, key assumptions and solution philosophies". In particular, explicit preference models and normative rationality requirements are typical of the MCDA field. In particular, monotonicity of the assignments w.r.t. the evaluations of the objects on the criteria (i.e., respect of dominance) is generally enforced in MCDA sorting methods. Some sorting methods have been developed that are inspired by classification methods as, for example, *k*-means. An example of such a proposal is the paper by Karasakal and Civelek (2021) in this issue. Actually, it may happen that dominance is not respected, but this occurs surprisingly rarely in the experiments made by the authors.

The survey by Zopounidis and Doumpos (2002) focusses on methods for learning additive utility models and Electre-Tri models on the basis of assignment examples (the so-called *preference disaggregation* approach, Jacquet-Lagrèze & Siskos, 2001). This research trend has hitherto been pervasive as testified by many publications in recent years. The paper by Madhooshiarzanagh and Abi-Zeid (2021) in the present issue illustrates this trend. It proposes a "disaggregation approach" for the Electre-Tri-nC sorting model. The latter is a variant of Electre-Tri, in which the objects are assigned to categories according to how they compare to limiting profiles[1] associated to the categories. In contrast, Electre-Tri-nC assigns to categories by comparing objects to several central (or typical) profiles associated to each category ("C" stands for "central" and "n" notifies that there may be several central profiles). The paper by Madhooshiarzanagh and Abi-Zeid proposes a method for learning the parameters of such a model based on a mixed integer linear programming formulation.

Two papers in this issue are devoted to a problem known under (at least) three different denominations: inverse sorting problem, benchmarking or post factum analysis. An assignment model being given, what are the minimal improvements to be made to an object in order to guarantee that it is assigned to a better category?

In Özpeynirci et al. (2021), the set of objects is defined extensionally and is typically small. An MR-Sort (Leroy et al., 2011) model is used to assign the objects to categories. The decision maker (DM) can modify the evaluation of an object on one criterion in exchange for a cost depending on the object and the criterion. The DM can then combine several such changes (e.g., modify the evaluation of an object on several criteria) in order to upgrade an object. There are of course several combinations of changes leading to the desired upgrade and an interactive algorithm is used to identify the preferred set of changes.

In Benabbou et al. (2021), the set of objects is defined intentionally and is typically very large: it is combinatorial. The objects are assigned to categories using a model based on a Choquet integral. Unlike Özpeynirci et al. (2021), given an object in a specific category, Benabbou et al. (2021) do not seek to modify the object in order to upgrade it. Instead, they look for another object close to the given one and in a better category, where the distance between objects is interpreted as a cost. They try to minimise this cost and solve this optimization problem using mixed integer programming. In a context where any solution has a cost, Benabbou et al. (2021) also consider the problem of finding an object with a lower cost while staying in the same category.

The last paper in this special issue deals with a complex type of sorting problems in which the evaluations of the alternatives are uncertain and evolve with time. Mouhib and Frini (2021) adapt the Electre-Tri method to a temporal context (multi-period evaluations) under stochastic uncertainty. The approach is illustrated by applying it to a sustainable forest management problem in Quebec.

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ENDNOTE

[1] This is why the original Electre-Tri method is now called Electre-Tri -B, "B" standing for boundary, that is, the limiting profiles.

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