

From Deterministic to Probabilistic Rough Sets

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Abstract. The presentation reviews the evolution, based on author's and associates' research, of 'soft' models of rough sets. It starts with the fundamental deterministic model of rough sets, as introduced by Pawlak (Pawlak 1982, Pawlak 1991), then is going over early models of variable precision approach to rough sets (Ziarko 1993, Katzberg and Ziarko 1996), and ending with the review of probabilistic models (Ziarko 2008, Ziarko 2021, Slezak and Ziarko 2005, Yao 2003, Yao 2008). In particular, the initial single control parameter variable precision model, based on the partial set inclusion relation is presented (Ziarko 1993). It is followed by the review of the variable precision models with symmetric and asymmetric bounds (Katzberg and Ziarko 1996). The most recent probabilistic and Bayesian models of rough sets are discussed next (Ziarko 2021, Ziarko 2008, Slezak 2005). Basic ideas and some properties of the discussed models are presented and their advantages and disadvantages, commonalities and differences are reviewed. Classification tables, rough decision tables and probabilistic decision tables are introduced and used to illustrate the presented notions, and also to emphasize the practical aspects of the presented methodologies. The classification tables and decision tables acquired from data are considered the main building blocks of the rough set-based real-world applications. The optimization and analytical aspects of the rough decision tables and probabilistic decision tables are discussed in the context of classical rough set notions of attribute dependencies, such as, functional, partial functional and probabilistic. The optimization involves computation of locally minimal sets of attributes (attribute reducts), minimal rules (value reducts) and significance factors of attributes, which are also discussed (Pawlak 1991, Ziarko 2014).

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