OBJECTIVE CLASSIFICATION OF EMPIRICAL PROBABILITY DISTRIBUTIONS AND THE ISSUE OF EVENT DETECTION

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ABSTRACT

While practically all multiple criteria approaches to decision analysis and support concentrate on rationally supporting *subjective* decisions, depending on some form of an elicitation of preferences of the decision maker, there are diverse decision situations where we should suggest decisions that are made *as objectively as possible;* the full objectivity is not attainable for many practical and philosophical reasons, but objectivity can be seen as an useful ideal or goal. Examples of such situations are, on the one hand, managerial decisions influencing many stakeholders, when an aggregation of preferences of stakeholders is impossible. On the other hand, such situations occur also in event detection; e.g., when automatically detecting a case of fire, we should not make decisions based on subjective, personal preferences. We shall call the problem of supporting decisions in such a case the problem of *objective classification* (treating problem of *ranking* as a special case with singleton classes and the problem of *decision selection* and *detection* as special cases with classes *selected – not selected* or *detected – not detected*). We can define objective classification as dependent only on a given set of data, relevant for the decision situation, and independent from any more detailed specification of personal preferences than that given by defining criteria and the partial order in criterion space. Already in this definition, we see the limits to objectivity, because naturally the definition of criteria and their partial order, or of the relevant set of data, can be treated as subjective; however, they are often much more obvious and easy to agree upon than the detailed preferences defined, e.g., by a utility function or a set of weighting coefficients.

Most of classical approaches to multiple criteria decision analysis and support, e.g., based on weighted sum aggregation, are not easily adaptable to the case of objective classification. From known approaches, either the goal programming or the reference point approaches are easily adaptable, because goals or reference points can be defined reasonably objectively from statistics in a given set of data. We concentrate here on reference point approaches, because they have the property of producing always Pareto optimal options (which is not the case in goal programming). The paper reviews the properties of reference point approaches

which make them useful for objective classification.

The paper concentrates on the issue of classification of empirical probability distributions (histograms), which is useful both in management situations and in event detection or event mining. While existing approaches to event detection concentrate on the use of selected moments or other characteristics of empirical probability distributions, we postulate that full empirical distribution preserves more of needed information then selected moments of this distribution, thus multiple criteria classification of distributions can be most effective in event detection. One of advantages of reference point approaches is that they easily deal with so-called *multiobjective trajectory* analysis and optimisation; this can be applied to issues of stochastic dominance and their generalisations needed for multiple criteria event detection based on classification of empirical probability distributions. The paper presents also examples of classes of practical event detection problems in which such formulation is useful.