

σ - μ efficiency analysis: A new methodology for evaluating units through composite indices

Salvatore Greco ^{a,b}, Alessio Ishizaka ^b, Menelaos Tasiou ^c, and Gianpiero Torrisi ^{a,c}

^a*Department of Economics and Business, University of Catania, Catania, Italy*

^b*University of Portsmouth, Portsmouth Business School, Centre of Operations Research and Logistics, UK*

^c*University of Portsmouth, Portsmouth Business School, Portsmouth, UK*

Abstract

We propose a new methodology to employ composite indicators for performance analysis of units of interest using Stochastic Multiattribute Acceptability Analysis. We start evaluating each unit by means of weighted sums of their elementary indicators in the whole set of admissible weights. For each unit, we compute the mean, μ , and the standard deviation, σ , of its evaluations. Clearly, the former has to be maximized, while the latter has to be minimized as it denotes instability in the evaluations with respect to the variability of weights. We consider a unit to be Pareto-Koopmans efficient with respect to μ and σ if there is no convex combination of μ and σ of the rest of the units with a value of μ that is not smaller, and a value of σ that is not greater, with at least one strict inequality. The set of all Pareto-Koopmans efficient units constitutes the first Pareto-Koopmans frontier. By removing this set and computing the efficiency frontier for the rest of the units, one could obtain the second Pareto-Koopmans frontier. Analogously, the third, fourth and so on Pareto-Koopmans frontiers can be defined. This permits to assign each unit to one of this sequence of Pareto-Koopmans frontiers. We measure the efficiency of each unit not only with respect to the first Pareto-Koopmans frontier, as in the classic Data Envelopment Analysis, but also with respect to the rest of the frontiers, thus enhancing the explicative power of the proposed approach. To illustrate its potential, we apply it to a case study of world happiness based on the data of the homonymous report, annually produced by the United Nations' Sustainable Development Solutions Network.

Keywords: OR in societal problem analysis · Composite Indicators · Weighting · Sigma-Mu efficiency · Stochastic Multiattribute Acceptability Analysis · Data Envelopment Analysis.