7. Conclusion

The algorithm presented in this paper aims at simplifying the task of building a multi-criteria decision model by using several preferences or evaluations, instead of describing the utility on each attribute and the importance of each attribute through the Möbius coefficients. The objective is to find a couple of utilities and Möbius coefficients $(\widehat{u}, \widehat{m})$ that fulfills all the constraints of monotonicity, normalization and the constraints related to the learning examples. As described, the problem is bilinear. To try to find a solution, we propose to use a fixed-point algorithm to alternatively find a $\widehat{m}$ according to a $\widehat{u}$ (denoted $compU(\widehat{m})$), and find a $\widehat{u}$ according to a $\widehat{m}$ (denoted $compM(\widehat{u})$). Each problem can provide a partial solution that does not validated all the constraints. This partial solution is then used in the next problem to see if the change of variables can provide a better solution. The solution is obtained when all the constraints are validated with a couple $(\widehat{u}, \widehat{m})$.

References

[1] J. Figueira, S. Greco, and M. Ehrgott, editors. *Multiple Criteria Decision Analysis: State of the Art Surveys*. Kluwer Acad. Publ., 2005.

[2] D.H. Krantz, R.D. Luce, P. Suppes, and A. Tversky. *Foundations of measurement*, volume 1: Additive and Polynomial Representations. Academic Press, 1971.

[3] M. Grabisch. The application of fuzzy integrals in multicriteria decision making. *European J. of Operational Research*, 89:445–456, 1996.

[4] M. Grabisch and Ch. Labreuche. A decade of application of the Choquet and Sugeno integrals in multi-criteria decision aid. *Annals of Operation Research*, 175:247–286, 2010.

[5] Ch. Labreuche and M. Grabisch. The Choquet integral for the aggregation of interval scales in multicriteria decision making. *Fuzzy Sets & Systems*, 137:11–26, 2003.

[6] M. Grabisch, I. Kojadinovic, and P. Meyer. A review of capacity identification methods for Choquet integral based multi-attribute utility theory — applications of the Kappalab R package. *Eur. J. of Operational Research*, 186:766–785, 2008.

[7] C. A. Bana e Costa and J.-C. Vansnick. A theoretical framework for Measuring Attractiveness by a Categorical Based Evaluation TecHnique (MACBETH). In *Proc. XIth Int. Conf. on MultiCriteria Decision Making*, pages 15–24, Coimbra, Portugal, August 1994.

[8] D. Bouyssou, M. Couceiro, C. Labreuche, J.-L. Marichal, and B. Mayag. Using choquet integral in machine learning: what can MCDA bring? In *Workshop from Multiple Criteria Decision Aid to Preference Learning*, Mons, Belgium, November 15-16 2012.

[9] Ch. Labreuche. Construction of a Choquet integral and the value functions without any commensurateness assumption in multi-criteria decision making. In *Int. Conf. Of the Euro Society for Fuzzy Logic and Technology (EUSFLAT)*, Aix Les Bains, France, July 18-22 2011.

[10] Ch. Labreuche. An axiomatization of the Choquet integral and its utility functions without any commensurateness assumption. In *Int. Conf. on Information Processing and Management of Uncertainty in Knowledge-Based Systems (IPMU)*, Catania, Italy, July 9-13 2012.

[11] S. Angilella, S. Greco, F. Lamantia, and B. Matarazzo. Assessing non-additive utility for multicriteria decision aid. *European Journal of Operational Research*, 158:734–744, 2004.

[12] J. Fürnkranz and E. Hüllermeier, editors. *Preference Learning*. Springer-Verlag, 2010.

[13] R. L. Keeney and H. Raiffa. *Decision with Multiple Objectives*. Wiley, New York, 1976.

[14] G. Choquet. Theory of capacities. *Annales de l'Institut Fourier*, 5:131–295, 1953.

[15] M. Sugeno. *Theory of fuzzy integrals and its applications*. PhD thesis, Tokyo Institute of Technology, 1974.

[16] G. C. Rota. On the foundations of combinatorial theory I. Theory of Möbius functions. *Zeitschrift für Wahrscheinlichkeitstheorie und Verwandte Gebiete*, 2:340–368, 1964.

[17] M. Grabisch. k-order additive discrete fuzzy measures and their representation. *Fuzzy Sets and Systems*, 92:167–189, 1997.

[18] M. Berkelaar, K. Eikland, and P. Notebaert. LP solve: Open source (mixed-integer) linear programming system. Technical report, Version 5.5 dated May 16, Rotterdam, The Netherlands, 2005.

[19] M. Grabisch and Ch. Labreuche. Fuzzy measures and integrals in MCDA. In M. Ehrgott J. Figueira, S. Greco, editor, *Multiple Criteria Decision Analysis - State of the Art Surveys*, pages 563–608. Springer's International Series, 2005.

[20] D. Schmeidler. Integral representation without additivity. *Proc. of the Amer. Math. Soc.*, 97(2):255–261, 1986.