Master thesis proposal

Exploration of interacting criteria in Multicriteria Decision Analysis: The case of electricity supply resilience assessment

Team

Project lead: Dr. Eleftherios Siskos* (Postdoctoral researcher)

Technology Assessment Group, Laboratory for Energy Systems Analysis, Paul Scherrer Institute (PSI), Villigen PSI, Switzerland

Principal investigator: Dr. Peter Burgherr (Technology Assessment Group Leader)

Technology Assessment Group, Laboratory for Energy Systems Analysis, Paul Scherrer Institute (PSI), Villigen PSI, Switzerland

Timeframe

Beginning the latest from January 2021, 6 months full-time

Location

Technology Assessment Group, Laboratory for Energy System Analysis (LEA), Paul Scherrer Institute (PSI), Switzerland (6 months)

Research background

Decision models nowadays aim at providing valueable support to stakeholders and decision makers, considering multiple conflicting objective functions or criteria. Specifically, in the field of Multicriteria Decision Analysis (MCDA), although evaluation criteria must be independent from each other, there are many instances, in which this is unavoidable. In that case, these criteria are called interacting and have attracted the focus of the scientific community in the recent years (Angilella et al. 2016).

The problem of electricity supply resilience assessment, on the other hand, being highly complex and multifaceted, includes such criteria, which, without the appropriate modelling processing and treatment, can endanger the validity of the decision model and its results (Gasser et al. 2020).

This Master thesis targets to mathematically examine the effect of criteria interactions on the evaluation results, building upon small-scale pilot problems, as well as the large-scale European resilience assessment problem.

* For more information:
email: eleftherios.siskos@psi.ch
website: https://www.psi.ch/en/ta/people/eleftherios-siskos

PAUL SCHERRER INSTITUT

PSI

Master thesis project context and objectives

This research project will focus on the complementary and fundamental procedure of criteria modelling, in the presence of interactions. Different kinds of interactions will be examined, such as mutual strengthening, mutual weakening and antagonistic, for the case of pairs and/or triplets of criteria.

The research work will be performed at a mathematical and modelling level, attempting to reveal the impact of criteria interactions on the efficacy and technical soundness of the modelling work, as well as on the emerging results. The interactions and the obtained MCDA results will be also validated, based on the correlation of the data of the interacting criteria, with a view to building potential mathematical relationships between them.

The practical contribution of this project lies in the facilitation of decision making in a real context, and the construction of theoretically sound models and results, when interactive criteria exist. Recent work in this direction has been advanced by (Grabisch, 1996 and Angilella et al. 2018, among others).

Broader benefits for the student

Decision models and decision support systems are currently of great importance in both the academic and the business sector as they can provide researchers, governmental bodies and stakeholders in depth knowledge of complex and multidimensional problems and guide them in a rational way to selecting their mostly preferred solutions. This project enhances the student's capacity on decision support systems, mathematical optimization and scientific management, providing him/her with key analytical and practical consultation skills, strengthening significantly his/her academic and business career outlook.

Student profile

- Familiarity with mathematical optimization, decision support systems and statistics
- Knowledge of at least one programming language: R, Matlab, Python
- Good familiarity with MS Office and in particular Excel.

References

Angilella, S., Corrente, S., Greco, S., Słowiński, R. (2016), Robust Ordinal Regression and Stochastic Multiobjective Acceptability Analysis in multiple criteria hierarchy process for the Choquet integral preference model, *Omega,* 63, pp. 154-169.

Angilella, S., Catalfo, P., Corrente, S., Giarlotta, A., Greco, S., Rizzo, M. (2018), Robust sustainable development assessment with composite indices aggregating interacting dimensions: The hierarchical-SMAA-Choquet integral approach, *Knowledge-Based Systems,* 158, pp. 136-153.

Gasser, P., Suter, J., Cinelli, M., Spada, M., Burgherr, P., Hirschberg, S., Kadziński, M., Stojadinović, B. (2020), Comprehensive resilience assessment of electricity supply security for 140 countries, *Ecological Indicators*, 110.

Grabisch, M. (1996), The application of fuzzy integrals in multicriteria decision making, *European Journal of Operational Research,* 89 (3), pp. 445-456.