Democratizing global sensitivity analysis with a no-code web dashboard.

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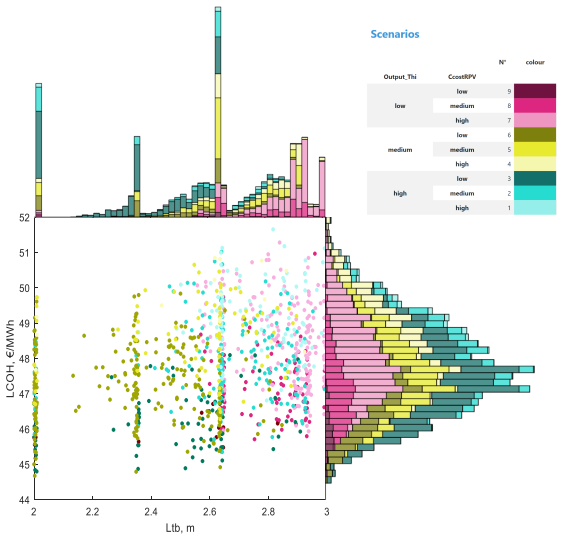
Global sensitivity analysis (GSA) is undoubtedly a valuable exercise to understand the behavior of a computational model and to devise an effective intervention. Moreover, policies and decisions that were based on a limited comprehension of uncertainty often turned out to be disastrous (5; 9; 1; 10). However, many factors contribute to **the near universal non-take-up** of GSA, including thematic complexity, implementation challenges, and computational costs (8). Furthermore, GSA lacks a visualization convention, which leads to the situation, where a majority of studies employing GSA compute the strength of the effects of input variables, but fail to examine their shape (2), which often can be critical for decision-making (3).

A hybrid sensitivity-uncertainty approach Simulation Decomposition (SimDec) was created to tackle the above challenges. At its core, it has an efficient computation of variance-based sensitivity indices (2), which further informs an intelligent visualization that transcribes multidimensional relationships onto a two-dimensional graph (3), all implemented in open-source packages and complemented by a no-code web dashboard freely accessible at https://simdec.io (6). SimDec as a method has been shown to provide added insights for the wide range of models from different fields (business, engineering, environment) and formulated in a variety of mathematical frameworks (4).



This conference presentation introduces the latest development in the SimDec dashboard: the two-output graphs. Its usefulness is demonstrated on the selected cases from operations research. The two-output graph consists of a scatterplot constructed for two arbitrary model outputs selected by the user, and the two corresponding histograms that show the marginal distributions of the two outputs. Further, the SimDec procedure is used to identify the most influential inputs for the first output and perform the decomposition by these inputs applied to the entire graph set: the scatterplot and the histograms become correspondingly color-coded.

The figure demonstrates the results of an optimization model for a heat exchanger of a nuclear district heating reactor (Saari et al.), in particular, the relationship between the two optimization outcomes, levelized cost of heat (*LCOH* on Y-axis) and the mechanical design characteristic (*Ltb* on X-axis), and their dependency on the two most influential input variables.

The optimization favors certain values of *Ltb* creating peaks in its distribution. *LCOH* slightly grows with larger *Ltb*. The inputs influence the mechanical design considerably, but not the LCOH, which is only slightly affected by the inputs.

Through the two-output graph on SimDec dashboard, the user acquires visual access to the multivariate input-output behavior of a model, supplied in an intuitive and interactive graphical format. The entire complexity of the GSA as a topic therefore remains behind the scenes, while being crucial in the process of creating meaningful graphics. Consequently, we believe that the dashboard has the potential to contribute in democratizing GSA, making its valuable functionality accessible for modelers even with limited mathematical training.

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