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# Which Sensitivity Analysis Method Should I Use for My Agent-Based Model?

Kevin Chapuis

► **To cite this version:**

Kevin Chapuis. Which Sensitivity Analysis Method Should I Use for My Agent-Based Model?. GAMA Days 2024, Nov 2024, Online, France. 10.18564/jasss.2857 . ird-04889364

**HAL Id: ird-04889364**

**<https://ird.hal.science/ird-04889364v1>**

Submitted on 15 Jan 2025

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# Sensitivity analysis made easy with Gama: current state and future prospects

Kevin Chapuis <sup>1</sup>

<sup>1</sup> UMR Espace-Dev, IRD

kevin.chapuis@ird.fr

## Keywords

Sensitivity analysis, Simulation exploration, scenario discovery

## Abstract

Sensitivity analysis (SA) is usually an overlooked steps in agent based modeling exploration (according to [3], 95% of simulation models reviewed do not use statistical validation techniques). This lack of scrutiny includes: to determine arbitrarily the number of replicates to flatten stochastic processes impact on simulation outcome, fixed arbitrary parameter values to lower the dimension of the problem to explore, empirical scenario search to find points of interest in the parameter space, weak evaluation and validation of simulation outcomes and parameter contribution; among other issues. Potential explanation includes lack of knowledge, duration of the procedure, computational power required, lack of generic techniques, algorithmic complexity and accessibility of methods [1].

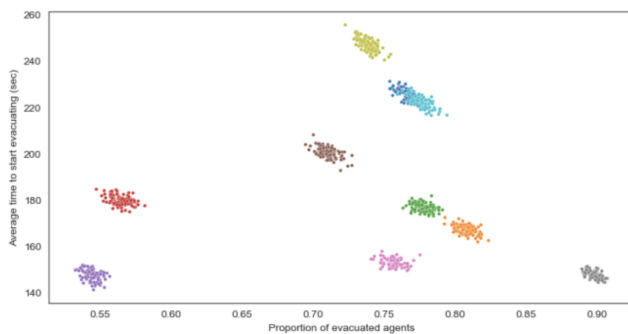


Figure 1: Stochastic reproductions of ten randomly sampled point in an agent based evacuation model [2]

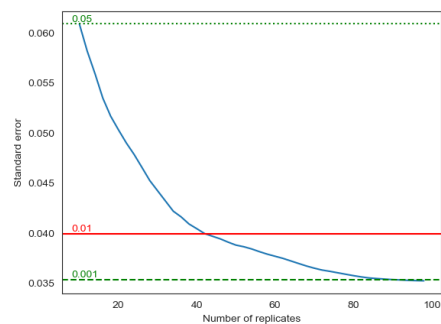


Figure 2: Averaged standard error over the 10 sampled points displayed in 1 for as much as 100 replicates, using the SALOAP library in Gama

For a long time, Gama platform philosophy about simulation analysis was to provide minimal feature to define simple exploration plans to be able to launch many simulations, replicate them and plot aggregated results. Rational behind this choice was that expert software (e.g. OpenMole) and programming language (e.g. R or Python) alternatives were more suitable providing established methodologies. However, it implies that modelers know those techniques, are familiar with other programming language and spent time to setup a loose/strong connection between Gama outcomes and the chosen software or API. Complexifying simulation analysis of models written with Gama, it further lower the accessibility of methods and implicitly call for a modeling exercise *per se*, often leaving modelers without guidance on how to build upon simulation results.

This communication revolve around the SALOAP library which had recently been packed with Gama 1.9.x and that will continue to add SA related features to the future release of the platform. The library provides methods and algorithms easy to use directly in Gama experiments, while being a first step procedure to better learn and design SA tailored for a particular model. It already includes assessing how many time you should replicate simulations (based on standard error, coefficient of variation or power test), what are the most influential parameters of your model (based on Morris, Sobol or  $\beta_d$  algorithm) and provides several strategies to explore your parameter space (sampling methods includes, uniform, factorial, Saltelli, orthogonal, latinhypercube). Future developments includes to automatically discover sub-spaces of interest using ML classification techniques, easy to build visual reports and recipes on how to organize simulation outputs.

## References

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