SALib: An open-source Python library for Sensitivity Analysis

Jon Herman[1] and Will Usher[2]

[1]University of California, Davis
[2]University of Oxford

11th October 2016

Paper DOI: http://dx.doi.org/10.21105/joss.00097
Software Repository: https://github.com/SALib/SALib
Software Archive: http://dx.doi.org/10.5281/zenodo.233103

Summary

SALib contains Python implementations of commonly used global sensitivity analysis methods, including Sobol (Sobol' 2001, Andrea Saltelli (2002), Andrea Saltelli et al. (2010)), Morris (Morris 1991, Campolongo, Cariboni, and Saltelli (2007)), FAST (Cukier et al. 1973, A. Saltelli, Tarantola, and Chan (1999)), Delta Moment-Independent Measure (E. Borgonovo 2007, Plischke, Borgonovo, and Smith (2013)) Derivative-based Global Sensitivity Measure (DGSM) (Sobol' and Kucherenko 2009) , and Fractional Factorial Sensitivity Analysis (Andrea Saltelli et al. 2008) methods. SALib is useful in simulation, optimisation and systems modelling to calculate the influence of model inputs or exogenous factors on outputs of interest.

SALib exposes a range of global sensitivity analysis techniques to the scientist, researcher and modeller, making it very easy to easily implement the range of techniques into typical modelling workflows.

The library facilitates the generation of samples associated with a model's inputs, and then provides functions to analyse the outputs from a model and visualise those results.

References

Borgonovo, E. 2007. "A new uncertainty importance measure." *Reliability Engineering and System Safety* 92 (6): 771–84. doi:10.1016/j.ress.2006.04.015.

Campolongo, F, Jessica Cariboni, and Andrea Saltelli. 2007. "An effective screening design for sensitivity analysis of large models." *Environmental Modelling & Software* 22 (10): 1509–18. doi:10.1016/j.envsoft.2006.10.004.

Cukier, R. I., C. M. Fortuin, K. E. Shuler, A. G. Petschek, and J. H. Schaibly. 1973. "Study of the sensitivity of coupled reaction systems to uncertainties in rate coefficients. I Theory." *Journal of Chemical Physics* 59 (8): 3873–8. doi:10.1063/1.1680571.

Morris, Max D. 1991. "Factorial Sampling Plans for Preliminary Computational Experiments." *Technometrics* 33: 161–74. doi:10.2307/1269043.

Plischke, Elmar, Emanuele Borgonovo, and Curtis L. Smith. 2013. "Global sensitivity measures from given data." *European Journal of Operational Research* 226 (3). Elsevier B.V.: 536–50.

doi:10.1016/j.ejor.2012.11.047.

Saltelli, A., S. Tarantola, and K. P.-S. Chan. 1999. "A Quantitative Model-Independent Method for Global Sensitivity Analysis of Model Output." *Technometrics* 41 (1): 39–56. doi:10.1080/00401706.1999.10485594.

Saltelli, Andrea. 2002. "Making best use of model evaluations to compute sensitivity indices." *Computer Physics Communications* 145 (2): 280–97. doi:10.1016/S0010-4655(02)00280-1.

Saltelli, Andrea, Paola Annoni, Ivano Azzini, F Campolongo, Marco Ratto, and S. Tarantola. 2010. "Variance based sensitivity analysis of model output. Design and estimator for the total sensitivity index." *Computer Physics Communications* 181 (2). Elsevier B.V.: 259–70. doi:10.1016/j.cpc.2009.09.018.

Saltelli, Andrea, M Ratto, T Andres, F Campolongo, J Cariboni, D Gatelli, M Saisana, and S. Tarantola. 2008. *Global Sensitivity Analysis: The Primer*. Wiley. http://books.google.co.uk/books?id=wAssmt2vumgC.

Sobol', I. M. 2001. "Global sensitivity indices for nonlinear mathematical models and their Monte Carlo estimates." *Mathematics and Computers in Simulation* 55 (1-3): 271–80. doi:10.1016/S0378-4754(00)00270-6.

Sobol', I. M., and S. Kucherenko. 2009. "Derivative based global sensitivity measures and their link with global sensitivity indices." *Mathematics and Computers in Simulation* 79 (10): 3009–17. doi:10.1016/j.matcom.2009.01.023.