Dana Meadows Award
Preferred Reporting Requirements

For further information and examples of preferred reporting requirements, see the paper
Reporting guidelines for simulation-based research in social sciences (pages 396–411)

Model reporting
Model reporting requirements should be followed whenever a simulation model is discussed or any results reported.

Any model used to generate research results must be reported so that independent parties can recreate the model and simulate it in the base case setting, on a computational platform of their choice, based on information provided in the reported research.

This requirement includes, but is not limited to:
*The computational operations the model is designed to perform shall be explained in plain text and provided within the paper or in an online appendix. Typically such documentation includes equations and algorithmic rules, all model parameters and initial values. The description should be sufficient to allow an independent third party to implement and simulate the model.

*If a model extends a previously published model in the publicly accessible literature that complies with these reporting requirements, only the changes from the previously reported model need to be described.

*Units of measurement for all variables and parameters .

*Sources of data (qualitative or quantitative) for different equations and algorithmic rules.

* Definition of all the variables used in the model and the logic behind their formulation.

* Source code in the original implementation platform, preferably in a format that can be freely accessed and simulated (e.g. for a Vensim model a .vpm or .mdl file that can be opened and executed by the freely available Vensim Model Reader).

Simulation experiment reporting

A simulation experiment consists of setting up the model and conducting one or multiple simulation runs that generate numerical results. Simulation runs may differ in their parameter settings, i.e., belong to different scenarios, or in their driving random number streams, i.e., being different realizations of the same scenario. The following reporting requirements apply to results reported from any simulation run(s).

Research should provide a detailed description of all the steps needed to repeat every reported simulation experiment and reproduce the results. Reproduced results shall be consistent with the reported results within the computational error bounds expected from reproduction on different platforms, and in the case of stochastic models, differences arising from different realizations of pseudo random numbers. These requirements include, but are not limited to, reporting of:

*The software and hardware platform(s) used for the simulation.

*The simulation algorithm used, such as integration method and time step (for differential and difference equation models), meshing method (for spatial models), and event prioritization schemes (for discrete event simulations).

*Any pre processing (e.g. to generate exogenous inputs to the model) needed on the base case model (described according to the requirement above) to enable reproduction of the reported experiments.

*Parameter settings required to reproduce any reported scenario, including parameter values for each scenario and, for Monte Carlo simulations, the joint distributions for the selection of parameters, including distributional forms, generating equations, and/or correlation matrixes, along with the sampling procedure used.

*The number of iterations per scenario.

*All post processing steps (e.g. aggregation computations, summary statistics, regressions on the simulation results) used to transform simulation outputs to reported results.

Reports of simulation experiments should include information that facilitates the assessment of the results beyond the minimum requirements. These include, but are not limited to specifying:

*If any sensitivity analysis was conducted on robustness of the algorithmic parameters (e.g. sensitivity of results to time step or simulation method).

*Information on computational costs, including simulation time and processor information. This is especially important if computational costs are significant.

*The random number generation algorithm used and the noise seed (parameters specifying the exact stream of resulting pseudo random numbers) for stochastic models.

*A measure of uncertainty (e.g., standard deviation, 95% confidence interval) in reported statistics in stochastic models and Monte Carlo analysis. The method used to calculate confidence intervals and other measures of uncertainty should be fully specified (e.g. empirical confidence interval vs. one calculated assuming variations are normally distributed).

*In stochastic models, when differences between metrics across different scenarios are reported, the statistical significance of the difference and the significance testing method.

*The method for determining the number of significant digits presented in tables and graphs. When original code is provided, instructions for conducting the simulation experiment in the original platform.

Optimization experiment reporting

Optimization experiments can be applied to deterministic or stochastic models and are used for policy optimization, calibration (estimating parameters of interest by minimizing some function of the error between the simulation and data), dynamic programming, and finding equilibria in multi player games, among others. The following information should be provided to enable reproduction of optimization experiments.

Besides following the Modeling Reporting Requirements, the optimization objective function, search algorithm and search space underlying the optimization procedure shall be specified with enough detail to enable the reproduction of the optimization experiment by independent researchers. Exact numerical reproduction may not be feasible due to variations in pseudo random number streams used in some optimization methods, or other platform based differences (e.g., in truncation or round off error). However the reproduced and reported results should, with sufficiently large samples, show no statistically significant differences. The minimum reporting requirements include, but are not limited to:

*The software environment in which the optimization has been implemented.

*The payoff function to be maximized (minimized) as a function of reported model variables. In game theoretic settings the payoff function of all the players involved shall be specified.

*The parameter space over which search for the best payoff value is conducted. If search parameters are not part of the model discussed above (e.g. feature space definition and functional approximations used for approximate dynamic programming (Bertsekas and Tsitsiklis 1996; Bertsekas 2007) the mapping of search parameters into model variables shall be reported.

*The search algorithm used shall be specified by reference to the original article introducing the algorithm and fully explaining any modifications or new search methods.

*If iterative methods are used, e.g. for finding game theoretic equilibria (Kim and Kim 1997; Sterman, Henderson et al. 2007; Rahmandad and Sibdari 2012), the number of iterations needed for convergence shall be reported.

*The actual search that has led to the reported optimization results based on the algorithm used, for example the number of restarts of the search in the parameter space, the total number of scenarios simulated, and the number of iterations per scenario (for stochastic models).

Reports of optimization experiments should go beyond the minimal requirements to include information that facilitates quick reproduction and the assessment of the results. These include, but are not limited to:

*Optimization implementation codes (e.g. Vensim payoff definition and optimization control files).

*Information on computational costs, including optimization time and processor information for each optimization experiment.

*For calibration/estimation results, a measure of uncertainty in the estimated parameters (e.g. 95% confidence interval).

*A measure of confidence in the generality of optimization results. Examples include the number of unique local optima discovered divided by the number of restarts, and for stochastic models, the confidence level that the best local optimum is found (as different random number streams will find different local optima in the neighborhood).