Statistical screening quantifies parameter influence on a specified performance variable throughout a simulation, thereby describing the evolution of exogenous impacts on behavior. Statistical screening uses multiple simulations generated by varying model input parameters to calculate correlation coefficients that measure the direction and strength of the relationship between input parameters and a user defined system performance variable. Values of correlation coefficients vary between -1 and +1, with the polarity denoting the direction of impact. Parameters with correlation coefficients with a value of “1” are perfectly correlated with the performance variable, correlation coefficients of “0” indicate no correlation, and correlation coefficients of “-1” indicate a perfectly inverse correlation. The method calculates correlation coefficients for each time unit of the simulation for each selected exogenous parameter, thereby generating time series of correlation coefficients for the selected exogenous variables. These are used to objectively identify high leverage parameters and the model structures that they influence. Those parameters and model structures can then be used to better understand how the model structure drives behavior, and to design improved system structures and management policies.