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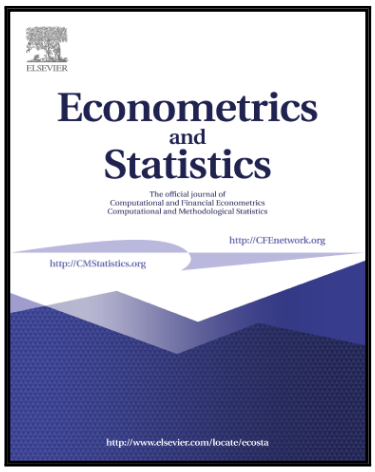

An Information Theoretic Criterion for Empirical Validation of Simulation Models

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An Information Theoretic Criterion for Empirical Validation of Simulation Models

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Abstract

Simulated models suffer intrinsically from validation and comparison problems. The choice of a suitable indicator quantifying the distance between the model and the data is pivotal to model selection. An information theoretic criterion, called *GSL-div*, is introduced to measure how closely models' synthetic output replicates the properties of observable time series without the need to resort to the likelihood function or to impose stationarity requirements. The indicator is sufficiently general to be applied to any model able to simulate or predict time series data, from simple univariate models to more complex objects including Agent-Based Models. When a set of models is given, a simple function of the L-divergence is used to select the candidate producing distributions of patterns that are closest to those observed in the data. The proposed approach is illustrated through three examples of increasing complexity where the *GSL-div* is used to discriminate among a variety of competing models. Results are compared to those obtained employing alternative measures of model's fit. The *GSL-div* is found to perform, in the vast majority of cases, better than the alternatives.

Keywords: Simulations, Empirical Validation, Model Selection, Time Series, Agent Based Models.

1. Introduction

In this paper we introduce a simple information-theoretic criterion, called *Generalized Subtracted L-divergence* (*GSL-div*), to measure the distance between the dynamics of time series produced by a simulation model and the empirically observable counterpart. The *GSL-div* can be used to quantitatively establish the empirical validity of a model and to discriminate between sets of competing ones. Various properties well suited to the scope of model validation are introduced and discussed. Unlike many other indicators, the *GSL-div* relies only on the synthetic data generated by simulations and does not impose any additional assumptions on the underlying stochastic processes. This feature makes the *GSL-div* especially well suited for validating Agent Based Models (ABMs), where the statistical properties of aggregate variables are *a priori* unknown (see Tesfatsion and Judd, 2006; Windrum et al., 2007). Further, it allows for direct comparisons among classes (e.g. macro Agent Based Models, Dynamical Stochastic General Equilibrium models and System Dynamics approaches).

Computer simulation models are implementations of sophisticated mathematical models that aim at reproducing a particular real process Paulo et al. (2012). Assessing the fit of different models with

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