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RESEARCH ARTICLE

Assessment of resampling methods for causality testing: A note on the US inflation behavior

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Abstract

Different resampling methods for the null hypothesis of no Granger causality are assessed in the setting of multivariate time series, taking into account that the driving-response coupling is conditioned on the other observed variables. As appropriate test statistic for this setting, the partial transfer entropy (PTE), an information and model-free measure, is used. Two resampling techniques, time-shifted surrogates and the stationary bootstrap, are combined with three independence settings (giving a total of six resampling methods), all approximating the null hypothesis of no Granger causality. In these three settings, the level of dependence is changed, while the conditioning variables remain intact. The empirical null distribution of the PTE, as the surrogate and bootstrapped time series become more independent, is examined along with the size and power of the respective tests. Additionally, we consider a seventh resampling method by contemporaneously resampling the driving and the response time series using the stationary bootstrap. Although this case does not comply with the no causality hypothesis, one can obtain an accurate sampling distribution for the mean of the test statistic since its value is zero under H_0 . Results indicate that as the resampling setting gets more independent, the test becomes more conservative. Finally, we conclude with a real application. More specifically, we investigate the causal links among the growth rates for the US CPI, money supply and crude oil. Based on the PTE and the seven resampling methods, we consistently find that changes in crude oil cause inflation conditioning on money supply in the post-1986 period. However this relationship cannot be explained on the basis of traditional cost-push mechanisms.

OPEN ACCESS

Citation: Papana A, Kyrtsov C, Kuglitzis D, Diks C (2017) Assessment of resampling methods for causality testing: A note on the US inflation behavior. PLOS ONE 12(7): e0180882. <https://doi.org/10.1371/journal.pone.0180882>

Editor: Zhong-Ke Gao, Tianjin University, CHINA

Received: December 5, 2016

Accepted: June 6, 2017

Published: July 14, 2017

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Data Availability Statement: The matlab codes for generating the corresponding simulation time series of the manuscript are provided as a Supplementary File. The financial time series from the real applications can be downloaded from the Federal Reserve Bank of Saint Louis at the following link: <https://fred.stlouisfed.org/categories>.

Funding: The research project is implemented within the framework of the Action "Supporting Postdoctoral Researchers" of the Operational Program "Education and Lifelong Learning" (Action's Beneficiary: General Secretariat for Research and Technology), and is co-financed by

Introduction

Connectivity analysis of multivariate time series is a rapidly growing branch of interest with applications in different fields, such as economy, climatology and brain dynamics. A variety of methods have been developed that uncover complex dynamical structures, i.e. analysis of

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