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RESEARCH ARTICLE

Evaluating the relationship between two periodically correlated processes with Mandelbrot-Van Ness fractional Brownian motion errors using periodic copula

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ABSTRACT

In many scientific fields such as meteorology, climatology and hydrology, one of major problems is to measure the relationships between some variables. To this aim, numerous parametric or non-parametric techniques have been introduced. But the applications of these approaches are usually restricted for some cases, for example, normal or stationary datasets. In this work, two periodically correlated time series with Mandelbrot-Van Ness fractional Brownian motion errors are considered and a novel technique to measure the relationship between them is introduced. The ability and power of the proposed method is evaluated using a deep simulation study. Moreover, the proposed procedure is used in a real world problem.

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Periodically correlated; fractional Brownian motion; relationship; copula

1. Introduction

In many scientific fields such as meteorology, climatology and hydrology, we are facing with different features and variables. One of major problems is to measure the relationships between these variables. Most of scientists usually employ different parametric or non-parametric coefficients of correlation such as Pearson [1,2], Spearman [3,4] and Kendall [5,6] to study the measure the relationships between the variables. Some of them use Sen's slope as a non-parametric tool [7,8]. When facing with two time series, the expert statisticians employ cross-correlation function [9,10] and copula [11–13]. When variables contain outliers or are abnormal, the cross-correlation function is not an efficient choice. In these cases, copula is usually employed as an efficient alternative. Previous studies indicated that if X_t and Y_t are two stationary time series then copula is a robust tool to measure the relationship between them. The theoretical and mathematical aspects of goodness of copula technique for stationary time series have been stated in previous literature. The copula technique is not a good choice for non-stationary processes such as periodically correlated processes. To obviate this subject, Mahmoudi and Mosavi [14] introduced a copula-based regression technique to detect relationship between two periodically correlated time series when the errors follow from the Riemann-Liouville fractional Brownian motion. Their

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